Engineering Library

JAN 24 1928

The Engineer.

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VOL. CXLV.—No. 3756] LONDON: FRIDAY EVENING, JANUARY 6, 1928 [PRICE {WITH SUPPLEMENTS} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Army Contracts.

NOTICE is HEREBY GIVEN that TENDERS for quantities of the undermentioned MANUFACTURED GOODS are INVITED from time to time as required :—

METAL TRADES, &c.

Aluminium Castings and Pressings, Bedsteads, Cutlery, Copperware, Enamelled Ware, Fencing, (Woven Wire and Strained Iron Wire), Field Forges, Hollow-ware, Lamps and Lanterns, Nails, Saddletrees, Safety Razors and Blades, Sash Chains, Scratch Card, Screws, Shovels, Stoves, Grates, &c., Telegraph Poles (Iron), Tinplates, Tinware, Tools, Tubing, Wire.

TEXTILE TRADES, &c.

American Cloth, Metal Badges and Buttons, Blankets, Braids, Jute Buckram, Canvas and Canvas Goods, Cloth, Cordage, Cottons and Cotton Goods, Cotton Waste, Cotton Waste for Guncotton, Elastic Webbing, Embroidery, Flags, Flannel, Head-dresses (including Bearskin Caps), Hessian, Horse Rugs, Hosiery (including Hose Tops), Lasting Cloth, Linens and Linen Goods, Moquette, Putees, Sewing Cotton and Thread, Silk, Sponge Cloths, Stockinette, Tapes, Tents, Turkish Towels, Uniform Clothing (made up from Department's own Materials), Webs, Woollen Drawers and Jerseys, Worsted Gloves.

ELECTRICAL AND SCIENTIFIC INSTRUMENT TRADES.

Cables, Electrical Stores, Scientific Instruments.

GENERAL TRADES.

Acid-resisting Stoneware, Boots and Shoes, Boxes and Chests, Brushes and Brooms, Candles, Chemicals (including Acetone, Alcohol, Aluminium Powder, Anhydrous Ammonia, Barium Nitrate, Magnesium Powder, Soda), Chinaware, Cocoanut Shell, Combs, Cooperage, Earthenware, Furniture, Glassware and Splinterless Glass, India-rubber Goods, Leather Goods, Paint (including Vermilion and Zinc Oxide, Dry), Palm Nut Shell, Powdered Ivory Nut, Soap, Stable Fitments, Timber, Vehicles, Woodware.

Manufacturers who are not already on any War Office list of tenderers, and who may wish to be invited to Tender for Army requirements of the above stores, should apply to the Director of Army Contracts at the address given below for Form 1, on which formal application for inclusion on the list of tenderers may be made. The services of an intermediary are unnecessary in approaching the Department for this purpose.

Before being placed on the lists of tenderers, firms will have to satisfy the Department that they actually manufacture goods for which they wish to be noted, and will be required to furnish the names of at least two well-known firms or public bodies who have purchased from them and are in a position to certify as to the quality of their productions. They will further have to give an undertaking that they will comply with the Fair Wages Resolution of the House of Commons.

Attention is called to the following resolution passed by both Houses of Parliament on 16th February, 1926 :—

"That in the opinion of this House it is the duty of the Government in all Government contracts to make provision for the employment to the fullest possible extent of disabled ex-Service men, and to this end to confine such contracts, save in exceptional circumstances, to employers enrolled on the King's National Roll."

SALES.—From time to time the Department has for sale surplus Army stores of various descriptions, among which may be mentioned Machinery, Steel Girder Bridges, Electrical Stores, Hutting, Mechanical Transport, Drugs, Medical and Dental Stores, Veterinary Stores, Laboratory Apparatus, Clothing, Textiles, Scrap Metals. Firms who wish to be invited to Tender for the purchase of surplus stores should apply as directed below.

All applications should be in writing and should be addressed to the DIRECTOR OF ARMY CONTRACTS, Carton House (West), Tothill-street, Westminster, London, S.W. 1. No application is necessary from firms whose names are already on the War Office lists, unless they have extended the range of their manufactures.

N. F. B. OSBORN,
Director of Army Contracts.

7378

TO ENGINEERS.

The Commissioners of

His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 20th January, 1928, for the INSTALLATION of HEATING, HOT WATER and FIRE SERVICES at Rampton State Institution, near Retford.

Drawings, specification, and a copy of the conditions and form of contract may be seen on application at, and bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions.

7399

The Director-General,

India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

LOCOMOTIVE BOILERS, LOCOMOTIVE CYLINDERS, and OTHER EQUIPMENT.

Tenders due on the 31st January, 1928.

Forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned.

7420

Air Ministry.

DIRECTORATE OF TECHNICAL DEVELOPMENT.

TEST ASSISTANTS are REQUIRED at the Royal Aircraft Establishment for work in connection with the airworthiness approval of aircraft.

Candidates should have had technical training to the standard of B.Sc. Degree in Pure and Applied Mathematics, Science or Engineering.

Works and drawing-office training, and experience in aerodynamic or structural strength calculations, or in the use of higher mathematics an advantage.

Salary 6ds. plus Civil Service bonus per week, giving a present total weekly remuneration of £4 12s. 7d.

Preference given, other things being equal, to ex-Service men.

Write, quoting reference No. A. 232, giving age and full particulars of technical training and experience, to the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants. 7400

Crystal Palace School of

PRACTICAL ENGINEERING.

President : J. W. WILSON, M.I.C.E., M.I.M.E., F.S.E.

Principal : MAURICE WILSON, M.I.C.E., F.S.E.

Vice-Principal : F. C. P. LAWRENCE, M.S.E., A.M.I. Struct. E.

EASTER TERM COMMENCES WEDNESDAY, JANUARY 11th. 7377

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

PROGRESS OF THE

ENGINEERING, SHIPBUILDING,

AERONAUTICAL

and

TRANSPORT INDUSTRIES

in 1927.

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PUBLIC NOTICES

Assistant Engineers Re-

QUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling will at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree or obtain such other diploma or distinction in engineering as the Secretary of State may decide in any particular case, or have completed articles with a Civil Engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition candidates must have had at least one year's practical experience of Civil Engineering under a qualified Civil Engineer.—Apply at once by letter, giving brief details of qualifications and experience and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15224.

7309

County Borough of Darlington.

LANCASHIRE BOILERS FOR SALE.

The Electricity Committee of the Darlington Corporation invite TENDERS for the PURCHASE of FIVE 28ft. by 8ft. LANCASHIRE BOILERS with Proctor Mechanical Stokers, suitable for a working pressure of 160 lb. per square inch. Three of these boilers are fitted with Sugden superheaters. Full specification can be obtained by application to the Borough Electrical Engineer, Haughton-road, Darlington.

H. HOPKINS,
Town Clerk.

Town Clerk's Office, Darlington,
30th December, 1927. 7359

Royal State Railways of Siam.

NOTICE.

Sealed TENDERS for the SUPPLY of 300 ALL-STEEL, FOUR-WHEELED, COVERED GOODS WAGONS and 50 PAIRS of WHEELS and AXLES will be received by the Administration of the Royal State Railways of Siam, Bangkok, until Fourteen o'clock on the 16th February, 1928, at which place and hour the Tenders will be publicly opened and read.

Blank Tender forms, general conditions, specifications and drawings may be obtained from Messrs. SANDBERG, 40, Grosvenor-gardens, London, S.W. 1, upon payment of £2, which sum will not be refunded.

Right is reserved to reject any or all Tenders, and to accept any Tender which is to the best interests of the Royal State Railways of Siam. 7395

PUBLIC NOTICES

Administrative County of

LONDON.

SUPPLY OF TRAMWAY RAILS, 1928-29.

The London County Council invites TENDERS for the SUPPLY and DELIVERY in London of :—

(a) About 3700 TONS of STANDARD TRACK RAILS and BOLTS and NUTS ; also

(b) About 800 TONS of CONDUCTOR RAILS, which will form the subject of a separate contract.

The specifications, bills of quantities, forms of Tender, drawings, &c., may be obtained on application to the Chief Engineer of the Council at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £2 in each case, by cheque or draft to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before the payment of the fee.

Correspondence and remittances by post should be addressed to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, or, if personal application is made, applicants should apply in Room 3A at No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract, and in the "London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 30th January, 1928, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
Clerk of the London County Council.

7363

Port of Bristol Authority.

EXTENSION OF THE ROYAL EDWARD DOCK, AVONMOUTH.

THIRTY PORTABLE AUTOMATIC SACK WEIGHERS FOR GRANARIES NO. 3 AND NO. 4.

The Port of Bristol Authority is prepared to receive TENDERS for THIRTY PORTABLE AUTOMATIC SACKING-OFF WEIGHERS for GRAIN for Granaries No. 3 and No. 4, Royal Edward Dock, Avonmouth.

On and after Wednesday, the 11th January, 1928, copies of the specification and contract drawings can be obtained from the undersigned on production of a receipt showing that a deposit of £3 has been paid. ALL CHEQUES MUST BE MADE PAYABLE to the "PORT OF BRISTOL AUTHORITY" and forwarded to the General Manager and Secretary, Docks Office, 19, Queen-square, Bristol. The deposit will be returned to bona fide tenderers after the receipt of the Tender with all the prescribed documents and drawings.

Tenders must be enclosed in a sealed envelope, endorsed "Tender for Automatic Weighers," addressed to the General Manager and Secretary of the Port of Bristol Authority, 19, Queen-square, Bristol, and must be delivered to him before 10 a.m. on Monday, the 30th day of January, 1928.

The Port of Bristol Authority does not bind itself to accept the lowest or any Tender.

THOMAS A. PEACE,
Chief Engineer.

Chief Engineer's Office,
Avonmouth Docks, Bristol,
6th January, 1928. 7385

PUBLIC NOTICES

Loughborough Corporation

WATERWORKS.

15-INCH MAIN FROM NANPANTON.

The Corporation of Loughborough invite TENDERS from competent contractors for PROVIDING and LAYING about 1¼ MILES of 15in. SPUN CAST IRON PIPES from Nanpanton to Loughborough.

The plans and specification may be seen at the office of the Consulting Engineers, Messrs. G. and F. Hodson, M. Inst. C.E., Bank Chambers, Loughborough, from whom copy of the particulars may be obtained on deposit of cheque for £5 5s., which will be refunded on receipt of bona fide Tender and the return of the documents.

Tenders to be sent to the undersigned not later than Monday, the 16th January, 1928.

The Corporation do not bind themselves to accept the lowest or any Tender.

Dated 23rd December, 1927.

HARRY PERKINS,
Town Clerk.

Loughborough. 7310

The Madras and Southern

MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—

(1) 27,633 FILES.

(2) 790 TONS STRUCTURAL STEEL WORK for IRONFOUNDRY (together with Corrugated Asbestos Sheets, Patent Glazing with Wired Glass, Galvd. C.I. Piping and Fencing Pales, &c. &c.).

(3) 2 PETROL TANK WAGONS, 4-WHEELED, I.R.C.A. STANDARD TYPE MK/1, complete with WHEELS and AXLES—METRE GAUGE.

Tenders are due in as follows :—

(1) and (3) by Tuesday, 24th January, 1928, at 2 p.m.

(2) by Wednesday, 15th February, 1928, at 10.30 a.m.

Tender forms obtainable at above address ; fee One Guinea each, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender. 7405

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED by a Leading Engineering Insurance Company, additional BOILER INSPECTORS. Age 28 to 32. Applicants must be practical engineers with technical training, holding a First-class or Extra First-class Board of Trade Certificate, capable of making accurately dimensioned sketches of all classes of steam boilers and writing clear reports on condition. Commencing salary £260 per annum.—Address, 7412, The Engineer Office. 7412 A

WANTED, ESTIMATOR, with Sound Experience in Engineering, Constructional and General Factory Building Work. Must have thorough knowledge of present-day costs and labour rates.—Address, 7281, The Engineer Office. 7281 A

WANTED for Spain, ASSISTANT ENGINEER. Good technical education and general engineering knowledge, experience in the operating and manufacturing with Disintegrators, Blowers, and Screen Plant. Prefer married man, age 25 to 30. Knowledge of Spanish an advantage.—Box R.M. 15, Brandis-Davis Agency, Ltd., 231, Strand, London, W.C. 2. 7408 A

WANTED, PRACTICAL WORKING ENGINEER, to Take Control of Erection of Fletton Brickworks as Clerk of the Works and afterwards, if satisfactory, to Take Charge of the Works.—Address, 7398, The Engineer Office. 7398 A

A YOUNG COMBUSTION ENGINEER is REQUIRED IMMEDIATELY by a company specialising in the manufacture of a full range of Boiler-house Instruments. We require a man who has had several years' actual boiler-house experience and a scientific training and education. He must be capable of dealing with the technical side of the manufacture of instruments and able to superintend boiler-house tests and assist in the design and development of new instruments. Please state details of education and experience, age, salary required, and say when at liberty. Applications will be treated in strict confidence.—Address, 7367, The Engineer Office. 7367 A

ASSISTANT REQUIRED by London Firm to PROMOTE SALES of MACHINERY and PLANT ; must have had good similar experience ; age minimum 30 ; fluent German indispensable ; state fully qualifications and salary required. Engineering experience heavier machinery advantageous. —Address, P4023, The Engineer Office. P4023 A

BUYER REQUIRED for Firm of Engineers and Contractors in Westminster.—Address, stating age, experience, and salary, 7416, The Engineer Office. 7416 A

COMMERCIAL MANAGER REQUIRED by Iron and Steel Rod Rolling, Wire and Wire Rope Manufacturing Company, employing over 1000 men ; experience of sales organisation and management essential ; adequate salary and prospects to the right man. Replies (treated in strict confidence) must be typewritten ; state age and experience.—Address, 7382, The Engineer Office. 7382 A

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SITUATIONS OPEN (continued)

COMPETENT PRODUCTION ENGINEER WANTED as ASSISTANT to WORKS MANAGER of Engineering Works in Yorkshire, employing about 850 men, engaged upon work partly manufactured in quantities, but also handling large amount of special jobs.
Position calls for man capable of handling diversity of work ranging from small items weighing a few ounces up to units weigning several tons. Exceptional opportunity for really live, energetic young engineer, possessing first-class organising ability and initiative, who would co-operate with existing staff to reduce production costs and increase output.
Applicants must state age, salary expected, and give details training and experience.
Address, 7352, The Engineer Office. 7352 A

ENERGETIC OUTDOOR REPRESENTATIVE, Headquarters London, REQUIRED by Chemical and General Engineers and Iron Founders. Must be experienced and capable of dealing with technical enquiries; also able to influence orders from Chemical Manufacturers and industrial concerns. State age, experience and salary required.—Address, P4022, The Engineer Office. P4022 A

ENGINEER SURVEYOR.—The ADVERTISERS, Box No. P3882, THANK all APPLICANTS and wish to state that the VACANCY has now been FILLED. P4013 A

FACTORY ENGINEER REQD. Near London. Exp. Steam Engine, Boilers, Generators and Power Station. Good control of men. Aged 35/45. Sal. £500/550 p.a.—Apply, LAURIE and CO., Employment Specialists, 28, Basinghall-street, E.C. 2. No preliminary fee. 7408 A

HEATING and VENTILATING SUPERVISING ERECTION ENGINEER REQUIRED IMMEDIATELY for London Engineers, with expert practical and technical knowledge.—Address, 7369, The Engineer Office. 7369 A

NORTH of ENGLAND Well-known CONCERN REQUIRE fully qualified COMBUSTION ENGINEER. Position is one of trust to Managing Director.—Address applications, with full particulars age, education, experience, salary, &c., 7376, The Engineer Office. 7376 A

JUNIOR ENGINEER REQUIRED by Firm of Assessors, with experience in preparing Schedules, Specifications, and Estimating. State qualifications age, and salary required.—Address, 7361, The Engineer Office. 7361 A

OLD-ESTABLISHED FIRM of ENGINEERS in India REQUIRE for their London office first-class ASSISTANT BUYER, experienced in the negotiation and purchase of Hardware, Metals, and Railway Stores; engineering training an advantage, but not essential; must be well educated; age 25-30.—Reply, giving fullest details education, experience, present appointment, and salary required, to Z.T. 763, care Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 7401 A

OPENING OCCURS for a GENTLEMAN with Practical and/or commercial engineering knowledge to resuscitate and reorganise the Sales Department of old-established Engineering Business whose fuel-saving appliances are well known at home and abroad. £3000 will secure controlling interest. Splendid opportunity for energetic man having organising ability.—Address, 7396, The Engineer Office. 7396 A

REINFORCED CONCRETE DESIGNER (Senior) WANTED QUICKLY.—Write, stating age, experience, and salary required, to INDUSTRIAL CONSTRUCTIONS, Ltd., 44, Grosvenor-place, S.W. 1. 7394 A

REPRESENTATIVE REQUIRED for Firm of Engineers and Contractors to call on prospective clients.—Address, stating age, experience, and salary, 7417, The Engineer Office. 7417 A

REQUIRED for Large London Printing Works, a young MECHANICAL ENGINEER. Willing to start at the bottom of the ladder; opportunity for progress. Factory hours.—Address, stating age, qualifications, experience, and also particulars of education, salary, &c., 7418, The Engineer Office. 7418 A

REQUIRED IMMEDIATELY, Capable GENTLEMAN with thorough knowledge of German and Machine Tool Trade. Must have initiative and be able to attend to extensive correspondence.—Address in own handwriting, stating age, qualifications and references, 7356, The Engineer Office. 7356 A

SALES ENGINEER REQUIRED, 25-35 Years, single, to sell Lubrication System. Salary £20 per month plus 5 per cent. commission on sales.—Address, giving full personal details, 7387, The Engineer Office. 7387 A

SECRETARY for Constructional Engineers' Offices, Manchester district. Fully qualified to take control of commercial side of business.—Address, stating age, experience, and salary in confidence, 7411, The Engineer Office. 7411 A

SUPERINTENDENT of PRODUCTION, Age About 35, REQUIRED by a progressive Company manufacturing Steam and Water Valves and Fittings. Applicant must be fully conversant in latest foundry and machine shop practice. Only those stating salary required and full particulars of qualifications and experience in own writing will be considered.—Write, "O.R.," c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 7357 A

THE PHŒNIX OIL and TRANSPORT CO., Ltd., has VACANCIES for recent Graduates holding the degree of B.Sc. (Engineering) as PROBATIONERS in OILFIELD ENGINEERING in Roumania. Preference will be given to men with practical training, but possession of the above degree is essential.—For particulars apply in writing to the COMPANY'S OFFICES, 9/13, Fenchurch-buildings, Fenchurch-street, London, E.C.3, stating degrees held and experience shop and/or drawing-office. 7410 A

WANTED, Experienced RAILWAY CARRIAGE and WAGON DRAUGHTSMEN.—Apply by letter, stating experience and salary required, THE BIRMINGHAM RAILWAY CARRIAGE and WAGON CO., Ltd., Smethwick. 7355 A

WANTED IMMEDIATELY, RESPONSIBLE DRAUGHTSMAN, with good experience in Design of Marine Engines (internal combustion petrol and paraffin). Consideration would also be given to applicants with sound knowledge of high efficiency motor-cycle engines. Works location, South Coast.—Apply in first instance, giving full details of experience and salary required, to Box 179, W. H. SMITH AND SON, Strand House, W.C. 2. P4014 A

4th January, 1928.

CIVIL ENGINEERING DRAUGHTSMEN REQUIRED for large works on N.E. Coast.
QUALIFICATIONS :—
CLASS A.—Large water mains and sewers, including flow calculations, lay-out work, estimates and specifications.
CLASS B.—Heavy foundations for buildings and machinery; brick buildings and sheds; estimates and specifications. Roads.
A knowledge of survey work and of simple reinforced concrete work is desirable. Ages 25 to 35. Salary according to qualifications; engagement on three months' probation, after which, if satisfactory, on agreement. Only fully qualified men need apply.
Address replies, 7415, The Engineer Office. 7415 A

CONSTRUCTIONAL DRAUGHTSMAN, Capable Detailer and reliable Checker, WANTED.—State age and salary required, BANISTER, WALTON and CO., Ltd., Trafford Park, Manchester. 7349 A

CONSTRUCTIONAL ENGINEERS REQUIRE DRAUGHTSMEN for works drawing-office. Must be good detailers, accustomed to all classes of Steel-framed Building.—Apply, stating age, experience, and salary, to LAMBOURNE and CO., Ltd., Victoria Steel Works, Openshaw, Manchester. 7366 A

DRAUGHTSMAN WANTED, Experienced in Structural and Mechanical Work in connection with Coal-handling Plants. Experienced men only need apply. State age, experience, and salary required.—Address, 7350, The Engineer Office. 7350 A

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A textbook covering the syllabuses of the B.Sc. (Eng.), A.M. Inst. C.E., and A.M.I. Mech. E. Examinations in this subject. In this third edition much new matter has been added. 384 pp. 10/6 net

Full particulars and complete catalogue, post free.

SIR ISAAC PITMAN & SONS, LTD.,
Parker Street, Kingsway, London, W.C.2.

SITUATIONS OPEN (continued)

DRAUGHTSMAN, Young Man with Knowledge of Light Steel-framed Buildings, for London drawing-office, with a view to future commercial work if proved suitable. State experience, age, and salary required.—Address, 7397, The Engineer Office. 7397 A

HEATING and VENTILATING DRAUGHTSMAN REQUIRED, with first-class experience, capable of designing and estimating for up-to-date Hot Water and Steam Systems. Preference will be given to a man with knowledge of Cooking and Laundry Plant for institutional purposes. Age 25 years or over.—Apply, CHIEF DRAUGHTSMAN, Barford and Perkins, Ltd., Peterborough. 7354 A

SITUATIONS OPEN (continued)

FIRST-CLASS DRAUGHTSMAN REQUIRED by well-known Firm in Midlands. Experience of Woodworking Machinery essential.—Write, Box E. 3770, Willing's, 30, King-street, London, W.C. 2. 7358 A

REQUIRED, CHIEF DRAUGHTSMAN for Firm of High-class Water-tube Boiler Manufacturers. Applicant must be fully experienced in Boiler, Superheater and Economiser design and all other sections relative thereto, also in Structural Design and Plant Lay-out.
Only first-class men need apply, stating age, experience, and salary required.
Address, 7381, The Engineer Office. 7381 A

SITUATIONS OPEN (continued)

LEADING STRUCTURAL DRAUGHTSMAN REQUIRED in Leeds; able to design and accustomed quick detailing of Steel Work for Factory and other Buildings. Give full particulars, experience, and salary required.—Address, 7400, The Engineer Office. 7400 A

MECHANICAL DRAUGHTSMAN REQUIRED for a Large Industrial Concern. Applicants must be well educated and have had sound training in workshop and drawing-office. One accustomed to Machine Design and Plant Lay-out preferred. Age not over 30.—Address, stating experience, training, references, and salary required, P4009, The Engineer Office. P4009 A

PRODUCTION DRAUGHTSMEN.—TWO REQUIRED IMMEDIATELY for Aircraft. In addition to experience as draughtsmen applicants must have been employed in fitting and machine shops on small parts.—Apply to Box 716, Shaw and Blake, Ltd., 8, Bell-yard, Temple Bar, London, W.C. 2, Advertising Agents. 7293 A

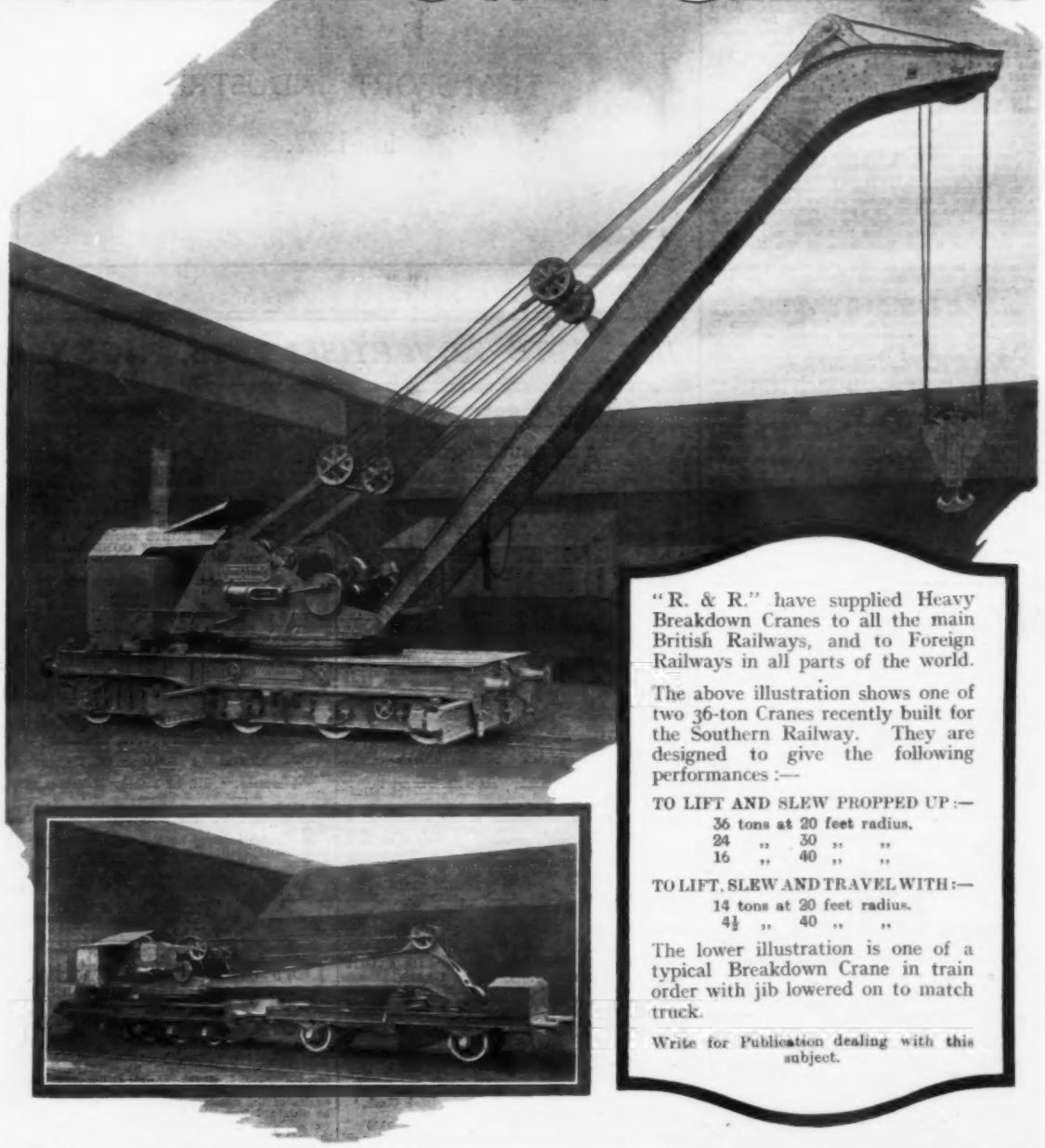
STRUCTURAL DRAUGHTSMEN REQUIRED for London works. One for Detailing and one for Estimating. The latter should be good designer, preferably with knowledge of L.C.C. 1909 Act. Good salaries and prospects for first-class men.—Write, stating age, experience, and salary required, Box 612, Dorland's, 14, Regent-street, S.W. 1. P4015 A

FOREMAN REQD. for British Guiana, Exp. Machine Shop and Loco. Repairs essential. Aged 32/37 only; £400/450 p.a.—Apply, LAURIE and CO., Employment Specialists, 28, Basinghall-street, E.C. 2. No preliminary fee. 7407 A

MACHINE SHOP FOREMAN WANTED by Long-established Manufacturers in Birmingham of well-known Motor Car Accessories. Good knowledge of Press Work is essential and some experience of Autos and Capstans. Applications will be treated in the strictest confidence and are wanted only from capable men experienced in the handling of male and female labour.—Address, 7371, The Engineer Office. 7371 A

For continuation of Small Advertisements see page 3.

BREAKDOWN CRANES



"R. & R." have supplied Heavy Breakdown Cranes to all the main British Railways, and to Foreign Railways in all parts of the world.

The above illustration shows one of two 36-ton Cranes recently built for the Southern Railway. They are designed to give the following performances :—

TO LIFT AND SLEW PROPPED UP :—
36 tons at 20 feet radius.
24 ,, 30 ,, ,,
16 ,, 40 ,, ,,

TO LIFT, SLEW AND TRAVEL WITH :—
14 tons at 20 feet radius.
4½ ,, 40 ,, ,,

The lower illustration is one of a typical Breakdown Crane in train order with jib lowered on to match truck.

Write for Publication dealing with this subject.

RANSOMES & RAPIER LTD.
WATERSIDE IRON WORKS, IPSWICH, ENGLAND.
R AND R

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A Seven-Day Journal

Submarine Aeroplanes.

CONSIDERABLE attention has been attracted this week by a notice from the Admiralty, published in the *London Gazette*, to the effect that an extra allowance of 2s. per day should be paid to qualified Fleet-Air Arm pilots and naval observer officers appointed to submarines carrying aircraft, and requesting an Order in Council sanctioning the recommendation. The terms of the notice clearly suggest that the carrying of aeroplanes on submarines in the British Navy has emerged from the purely experimental stage. The notice is of interest because it is the first public official intimation that this country possesses submarines capable of carrying aircraft and aircraft capable of being released from them. It should be evident that the restrictions of space imposed on the designer of an aeroplane suitable for use on a submarine are such as to tax to the fullest extent his ability to produce a serviceable machine. Other countries, notably France and the United States, have been studying the problem, and evidence has been available for some time that they have solved it with a certain measure of success. The task involved does not stop with the production of a small aeroplane capable of being folded and housed within a watertight compartment of little size. It is evident that provisions of a special nature must be made for launching the machine and for its return to the submarine. How the whole problem has been solved in the British Navy we do not know. Given the machine, however, it is possible that launching is accomplished by means of a hydraulically operated catapult. Alternatively it may be that the machine is a small seaplane, and that after being slipped over the side it takes off from the water. This system would permit the machine to alight on the water alongside the submarine, whence it would be hoisted on board. An aeroplane launched from a catapult would find it difficult to return to its quarters on the submarine.

The New Year Honours.

AMONG the honours conferred by his Majesty the King on the occasion of the New Year, those awarded to engineers are very few. Chief among them is the Knight Bachelorship conferred upon Dr. T. E. Stanton, the superintendent of the Engineering Department at the National Physical Laboratory. A similar honour has been conferred on Mr. J. R. Brooke, the secretary to the Central Electricity Board, and on Mr. A. A. Biggs, agent to the Madras and Southern Mahratta Railway. Companionships of the Bath have been awarded to Engineer Rear-Admiral F. W. Sydenham and Colonel C. Russell-Brown, Chief Engineer, South China Command. Companionships of the Indian Empire have been conferred on Mr. A. T. Stowell, acting agent North-Western Railway of India, and on Mr. A. R. Astbury, chief engineer, Public Works Department, Punjab. Sir Frank Baines, Director of Works to his Majesty's Office of Works, has received a Knight Companionship of the Royal Victorian Order.

Sale of Australian Commonwealth Line.

THE announcement is made that the Government of Australia is prepared to receive tenders for the purchase of the whole of the ships and material of the Australian Commonwealth Line. A reservation, however, is to be made with regard to the shipbuilding and ship-repairing yard at Cockatoo Island, from which it is understood that in future that yard will be used for naval work. As it stands to-day the Commonwealth fleet comprises five Bay steamers and two cargo vessels. Of these ships, the Esperance Bay, and the Largs Bay, were built by William Beardmore and Co., Ltd., and the Hobsons Bay, the Jervis Bay, and the Moreton Bay by Vickers, Ltd. They are all 15-knot ships with oil-fired boilers and a gross tonnage of close upon 13,800. The two cargo vessels the Ferndale and Fordsdale are 9600-ton ships, designed for about the same speed, and were built at the Commonwealth Dockyard, New South Wales. The Commonwealth line was brought into being in 1916, when Mr. W. M. Hughes purchased fifteen cargo steamers for £2,000,000. After the war twenty-eight additional steamers were bought, including American and ex-German ships, and orders were placed in this country for the five cargo liners we have referred to, in addition to which a number of smaller vessels were built in Australia. By 1922 the Commonwealth fleet of steamships numbered over fifty, but it was soon found that the vessels were being operated at a loss, and the following year all the older and smaller ships were sold at a very heavy sacrifice. Even the Bay steamers were built at a time of high prices, and they cost close upon a million pounds each. This experiment of State-owned shipping, though bold in its conception, has proved a failure financially. The exact conditions governing the sale of the present fleet will only be made known to actual bidders, but it would appear that objection will not be raised to the transference of the ships to the British register should the purchaser require such transfer, which is almost certain to be the case, as the Australian register conditions are so onerous as to prevent them being profitably operated on ocean routes.

The Lentz Engined Cargo Steamer Holystone.

THE cargo steamer Holystone, which was built by Short Brothers, Ltd., of Sunderland, to the order of Common Brothers, of Newcastle-upon-Tyne, for the service of the Northumbrian Steam Shipping Company, Ltd., is of especial interest, as she is the first steamer to be propelled by a British-built Lentz type marine steam engine. An illustration of the engine, together with a brief description of it, will be found in our annual review of steam marine engineering progress, which appears elsewhere in this issue. It was built by John Dickinson and Sons, Ltd., of Sunderland, and has a designed output of 1700 I.H.P. at 70 r.p.m. A double compound arrangement of cylinders is used, there being two 20½in. diameter high-pressure cylinders and two 43½in. diameter low-pressure cylinders with a common stroke of 43½in. The inlet and exhaust valves are of the Lentz poppet pattern. Steam at a total superheated temperature of 620 deg. Fah. and a working pressure of 220 lb. per square inch is supplied by two multitubular boilers working under natural draught. The Holystone has a designed deadweight carrying capacity of about 9000 tons and her extreme dimensions are 410ft. in length and 54ft. in breadth, with a depth moulded of 31ft. 6in. Very complete cargo discharging equipment is fitted and the holds are specially arranged for the carriage of grain in bulk. It is understood that the engine builders will give further particulars of the performance of the ship after she has returned from her first voyage.

Joint Conference of Employers and Employed.

ARRANGEMENTS have now been completed under which a joint conference between the General Council of the Trades Union Congress and a large group of representative employers will be opened at Burlington House, London, on Thursday afternoon of next week, January 12th. The conference is the outcome of an invitation addressed to the General Council by certain employers, in which it was suggested that a meeting should be held to consider "certain fundamental factors in industrial reorganisation and industrial relations with a view to the formulation of definite and concrete proposals applicable to, and to be determined in detail by, the various industries concerned." The General Council has authority to speak on behalf of four million trade unionists. On the employers' side an aggregate capital value of nearly a thousand million pounds is represented. Among the leading industrialists who signed the letter of invitation were Sir Alfred Mond, Lord Aberconway, Sir Herbert Austin, Lord Colwyn, Sir A. Dorman, Sir Robert Hadfield, Sir Hugo Hirst, the Marquis of Londonderry, Lord Weir, and Sir Peter Rylands. The signatories expressed their belief that the common interests which bind employers and employed are more powerful than the apparently divergent interests which seem to separate them, and pointed out that there did not seem to be a single existing organisation of employers which could take the initiative in promoting a discussion that would cover the entire field. It is not anticipated that the meeting next week will result in rapid progress being made towards the achievement of the object for which the conference has been convoked. It will probably be found necessary to appoint a number of committees to investigate separate subjects. It is hoped, however, that the meeting will mark the opening of an era of discussion that will result in the creation of permanent machinery for joint consultation and joint effort aiming at the development of industrial progress.

Broadcast Reception in Birmingham.

WHEN the Daventry experimental wireless station, "5 GB," replaced the local Birmingham transmitter in August of last year a single low aerial was provided, but after a short trial it was found that satisfactory reception in Birmingham could not be guaranteed. The reason was that a certain amount of shielding was caused by the masts of the long-range Daventry station 5 XX, and it was therefore decided to erect a second low aerial parallel to the first and designed to radiate in the Birmingham direction. Considerable improvement was found to result in the Birmingham area, but having in mind another important aspect of the 5 GB experiments, namely, the provision of data in connection with the scheme of regional stations, the British Broadcasting Corporation proceeded to erect masts 300ft. high, which, it was thought, might ultimately replace the low double masts. Experiments have recently been carried out with the new masts, but it appears that the shielding effect in the Birmingham direction is likely to be accentuated by their use. The next step, therefore, will be to rearrange these 300ft. masts in such a way as to maintain the present signal strength in Birmingham while giving a greater all-round strength to that portion of the rest of the country that is within the range of 5 GB. The general efficiency of the new aerial has been definitely proved to be greater than that of the twin aerial at present in operation, and the experiments for which it is designed will be of considerable value in connection with the regional scheme.

Low Temperature Carbonisation.

A VERY glowing picture was drawn of the present state and future prospects of the improved Parker process at the annual general meeting last week of Low Temperature Carbonisation, Ltd., by the chairman of the company, Sir Arthur Wheeler. The company was reconstructed in July, 1926, and under the charge of Mr. Charles Parker, son of the late Mr. Thomas Parker, the founder of the company's process, re-designed plant has been erected at Barugh. It is claimed that for the first time the Parker low-temperature carbonisation process can now be carried out with complete success, both from the technical and commercial standpoint. According to Sir Arthur Wheeler, the company has concluded an agreement with the Askern Colliery, near Doncaster, for the erection at the pithead of a plant capable of dealing with 500 tons of coal per day. That plant is to be completed this year, and it and the Barugh plant will have a joint capacity for treating 270,000 tons of coal per year. From that amount some 180,000 tons of the smokeless fuel known as Coalite will, it is anticipated, be obtained. Plans are under consideration for the manufacture of "Coalite" to a standard specification by a ring of collieries in England and Wales, the finished product together with the oil being marketed by a central sales organisation. Sir Arthur claimed that the improved Parker process is the only low-temperature carbonisation system working on a production and profit-earning basis and yielding a smokeless fuel, such as Coalite, as its chief by-product, and that it is equally suitable for dealing with coking and non-coking coals. The services of Lieut.-Colonel W. A. Bristow have been secured for the company by his appointment to the post of managing director.

Naval Construction in 1927.

ALTHOUGH the past year was rendered noteworthy, so far as naval shipbuilding is concerned, by the completion of important ships at home and abroad, it witnessed no special activity in any quarter, and there was a complete absence of anything which could possibly be interpreted as competitive building. On the contrary, the rate of construction was abnormally slow. Every naval programme, including our own, is well behind time. The laying-down of new keels has, in many cases, been postponed till long past the dates originally contemplated, and on vessels already laid down work has proceeded at a leisurely pace. Generally speaking, the time now taken to build and fit out a warship of major tonnage is almost twice as long as before the war. This, of course, is due, not to any falling off in dockyard or workshop efficiency, but to economic and political factors. At the same time it is true that the latest type of battleship is both considerably larger and more complicated in design than her forerunner of pre-war days, and this circumstance may account in some measure for the slower rate of construction, as exemplified by the battleships Nelson and Rodney, each of which has taken over four and a-half years to complete. Irrespective of the reasons mentioned above, the tardy construction of these vessels, and of the first "County" cruisers, was attributable in part to labour disputes, which have been the bane of the shipbuilding industry in recent years.

British Empire.

The largest vessels completed in 1927 were the twin battleships Nelson and Rodney—see Supplement—the first in October, the second a month later. Both were laid down in December, 1922, The Nelson was built by Armstrong, Whitworth and Co., and engined by the Wallsend Slipway and Engineering Company, while her sister ship was both built and engined by Cammell Laird and Co., As the type has already been fully described in these columns, it only remains to supplement the leading dimensions, &c., by certain data which have recently been released by the Admiralty. The length is 660ft. between perpendiculars, and 702ft. over all; the extreme breadth is 106ft., the mean draught 30ft., and the standard displacement 35,000 tons. As the latter figure includes neither oil fuel—of which 4000 tons can be stowed—nor reserve feed water, it is clear that the actual displacement will be nearer 40,000 tons. The fuel capacity, which is greater than that of any previous battleship, is surpassed only by the battle cruisers Renown and Repulse, which carry 4289 tons and 4243 tons respectively. The machinery, consisting of turbines driving twin screws through single reduction gearing with large bearing surfaces for the pinion and wheel bearings, has a designed output of 45,000 S.H.P. Each set comprises one high and one low-pressure turbine. The admission of steam to the turbines is regulated by nozzles and inter-stage valves. There are eight water-tube boilers of the three-drum small tube pattern. During their trials both ships exceeded the designed power, and a higher speed than the 23 knots specified in the contract was attained in each case. They have proved to be remarkably economical in fuel consumption, which at full power is 30 per cent. less than that of the Revenge, a battleship of corresponding speed but smaller tonnage. At cruising speed the new ships burn only 2·7 tons an hour, and proportionate to their size they are probably the most economical steamers in the Navy. Electric or electro-hydraulic power has been largely adopted for the auxiliary plant, such as boat hoists, capstans, turret machinery, steering gear, secondary armament ammunition hoists, pumps, fans, &c. The hull has no external bulge, but underwater protection is more complete than in earlier capital ships. The main armour belt has a thickness of 14in., turret armour varies from 11in. to 9in., and there is robust deck protection, which is believed to confer immunity from serious damage by air bombs. The nine 16in. guns are of a new model, 45 calibres in length, and are housed in triple turrets, which offer a very small area of target. It is well known that the mountings of these guns embody many novel features. The twelve 6in. guns, twin-mounted in closed turrets, appear to have a very high angle of elevation, and could presumably be used against aircraft under favourable conditions. Two torpedo tubes are fitted, including one in the bows—a position which has evoked criticism. The cost of these battleships, complete, is £7,405,269 for the Nelson, and £7,488,274 for the Rodney. Both have now joined the Atlantic Fleet, the former as flagship of the Commander-in-Chief. Under the Washington Treaty no further capital ship may be laid down for the British Navy until the year 1931.

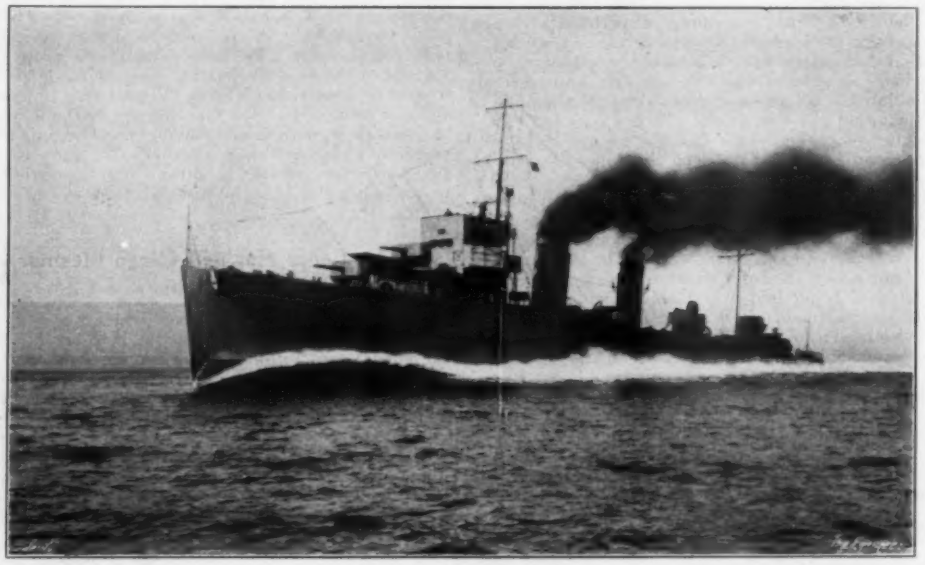
Of the five "County" cruisers provided for in the programme of 1924 and laid down towards the end of that year, only the Berwick had been placed in full commission at the moment of writing. This vessel was built and engined by the Fairfield Company. The Cumberland, built and engined by Vickers, was to have been ready for sea in September last; the Cornwall, built at Devonport (engined by Beardmore), in October; the Suffolk, built at Portsmouth (engined by Parsons), in November; and the Kent, built at Chatham (engined by Hawthorn Leslie), in February, 1928; but all four ships appear to have been somewhat delayed. With the exception of the Berwick, the first group of "County" cruisers has taken over three years to complete. All essential details of this type have now been released. The length is 590ft. between perpendiculars, and 630ft. over all; breadth, 68ft. 4in.; mean draught, 16ft. 3in.; standard displacement, 10,000 tons. The machinery consists of geared turbines designed for 80,000 S.H.P., taking steam from boilers of the Yarrow pattern. Although the contract speed of 31½ knots is rather below that of contemporary foreign cruisers, the steam trials of the Berwick and the Cumberland are understood to have shown that the ships of this class can not only reach their designed speed with ease, but, thanks to their high freeboard and beautiful lines, are able to maintain in all but the severest weather a steady sea speed which is believed to be not inferior to the best pace of any foreign cruiser on a protracted run. Where the "County" cruisers excel is in respect of their steaming endurance. Owing to the large fuel supply of 3400 tons and the economical working of the machinery, they are able to cover a greater distance, whether at full, medium, or low speed, than any other cruising ship now afloat. Protection is afforded by bulges along the water-line, strong steel decks, and armoured trunks to the munition hoists. The 8in. guns, of which eight are mounted, are the most powerful and longest-range weapons of medium calibre ever carried in British warships. They are 50 calibres in length, the projectile weighs 283 lb., and as the mountings permit of great elevation the extreme range is probably only limited by visibility. In view of aviation developments in other navies, we hope that it will be found possible to equip these vessels with aircraft. The design is, on the whole, an admirable one, and such improvements as the trials have suggested will be worked into later vessels of the same generic type. Two of these were launched in the year, the London—see Supplement—at Portsmouth, in September, and the Devonshire at Devonport in October. The Shropshire, which is being built by Beardmore, and the Sussex, by Hawthorn Leslie, are expected to go afloat early in the present year. They are practically replicas of the "Kent" class, but the designed speed is unofficially reported to be 32 knots. Two further cruisers of the 10,000-ton class were begun in 1927, the Dorsetshire at Portsmouth and the Norfolk by the Fairfield Company. There are, finally, the two Australian ships, Australia and Canberra, which were launched by John Brown and Co., at Clydebank, last year on March 17th and May 31st respectively, and are due to be completed in the coming spring. Thirteen cruisers of the heaviest type permitted by Treaty have therefore been provided for the the naval forces of the British Empire. The Government has decided to suspend the construction of further vessels of this class in the hope of promoting a new international agreement for the restriction of naval armaments. The York, a "B" class cruiser, of approximately 8400 tons, to carry six 8in. guns, was begun during the year by Palmers Shipbuilding Company, at Jarrow, and a second vessel of the same class is to be laid down at Devonport on March 15th next. No other cruisers are projected for the time being.

Our first post-war destroyers, Amazon and Ambuscade, completed their trials early in the year, in both cases with success. The Amazon, of 1330 tons, was built by Thornycroft; the Ambuscade, of 1210 tons, by Yarrow. These vessels, which have previously been described in THE ENGINEER, have Yarrow boilers and Brown-Curtis geared turbines developing 35,000 S.H.P. Their designed speed of 37 knots is the highest yet attempted in British destroyers. During her official speed trials on the Clyde last March, the Amazon attained a mean of 37·47 knots on a six-hour run. On the measured mile her mean speed was 37·96 knots. They differ from earlier destroyers in the increased height of freeboard, the larger fuel capacity, and improved accommodation for the *personnel*. Contracts for one flotilla leader and eight destroyers are to be placed this year, but no details of these vessels are obtainable.

Three submarines were completed during the year, the Oberon for the Royal Navy, the Oxley and Otway for the Royal Australian Fleet. The first named is a boat of 1346 tons, mounting one 4in. gun in and armoured position. The Australian boats are of similar design but about 50 tons heavier. The British building programme for 1927–28 includes six further submarines of the "O" class, which have not yet been ordered. Other boats of the same class now on the stocks are the Odin (Chatham), Olympus and and Orpheus (Beardmore), Osiris, Oswald, and Otis (Vickers), belonging to the 1926–27 Navy Estimates. According to an answer given in Parliament last month, the huge submarine X. 1 is still officially listed as "building." This vessel was begun more than six years ago, and is understood to have served a commission in the Mediterranean Fleet.

United States.

The outstanding event of the year was the completion of the aircraft carrier Saratoga. This vessel—see Supplement—the largest ship of any description hitherto completed in the United States, was begun in September, 1920, at the New York Shipbuilding Company's yard—now operated by the American Brown-Boveri Company. She was designed as a battle cruiser, but the Washington Conference caused work to be stopped on her and her sister, Lexington, and subsequently both were re-designed as aircraft carriers. The change involved a reduction of 10,000 tons in the displacement, and as the propelling machinery has not been altered, it is expected that the speed will be considerably higher than that originally specified. The length of the ship is 850ft. between perpendiculars and 888ft. over all. The maximum breadth of the flight deck is 106ft., and the draught at the legend displacement of 33,000 tons is 30ft. The turbo-electric propelling plant develops 180,000 S.H.P., and a speed of 34½ knots is expected. The power of this machinery exceeds the combined output of the six American battleships equipped with electric drive, viz., the New Mexico, California, Tennessee, Maryland, Colorado, and West Virginia. It is understood that the hull is armoured on the water-line and has bulge protection associated with a very elaborate system of subdivision. Eight 8in. 50-calibre guns, in double turrets, form the main armament, and there are twelve 5in. 25-calibre guns for use against aircraft. The turrets, bridge, mast, and a huge elliptical funnel casing are all placed at the extreme starboard side of the flight deck, the boats being stowed in recesses on the deck below, where the A.A. guns are also emplaced in groups of three. It is of interest to note that the boilers in both the Saratoga and the Lexington—the highest-powered ships ever built—are of British design. The former has sixteen White-Forster boilers, while the Lexington has the same number of Yarrow generators. The working pressure in both types is 295 lb. to the square inch. Each of the four propeller shafts is driven by two electric motors of 22,500 H.P. each. There are, besides, nearly a thousand motors for auxiliary purposes, and it is stated that every mechanical operation on board is performed by means of electricity. Stowage space is provided for 85 aeroplanes, but it is obvious that



H.M. DESTROYER AMAZON

only a small proportion of that number could be handled at the same time. The complement of the Saratoga numbers 2034 officers and men, 565 of whom are borne for aviation duty. The Lexington will probably go into commission next month. These ships have been severely criticised in American naval circles on account of their enormous size, heavy cost (about £8,500,000 each), and vulnerability, and it is certain that no further units of the class will be built. The aircraft carriers projected in the new programme will displace only 13,000 tons.

The first two cruisers of the "Treaty" class, Pensacola and Salt Lake City, which were laid down in the summer of 1926, are still on the stocks, the former at New York Navy Yard, the latter at the Camden Yard of the American Brown Boveri Company. Their particulars are as follows:—Length overall, 585½ft.; breadth, 65ft. 2in.; draught, 19ft. 6½in.; standard displacement, 10,000 tons. Protection appears to be meagre. According to a semi-official report, "while provision has been made for protection against gunfire, torpedo attack, and air bombs, as far as practicable, defensive power has been sacrificed for speed and offensive power. The new cruisers will be extremely vulnerable, relying largely on speed and handiness for their defence." In view of the sweeping claims which have been made on behalf of the electric drive, it is significant that these ships are to have geared turbine propulsion. The steam pressure is said to be 700 lb., though this has yet to be confirmed. The designed speed is 33 knots. Ten 8in. guns are mounted in two triple and two double turrets on the centre line. There are also four 5in. short-calibre A.A. guns and six torpedo tubes. This is the heaviest armament carried by any existing cruiser of the "Treaty" class. Both ships are due for completion in August, 1929. Six later vessels were ordered last year, one from the Bethlehem Shipbuilding Corporation, one from the American Brown-Boveri Company, two from the Newport News Company, and one each from the Navy Yards at Puget Sound and Mare Island. They will closely resemble the "Pensacola" class, save that the armament has been reduced to nine 8in. guns in triple turrets.

The only war vessel of any importance to be launched during the year was the minelaying submarine V 4, which went afloat at the Portsmouth (N.H.) Navy Yard on November 10th. This boat is 381ft. long overall, has a maximum breadth of 33ft. 7½in., and displaces 2878 tons on the surface. She is the largest submarine which has been launched, so far, for any navy, her displacement exceeding that of X 1 by 353 tons, and her length by 21ft. Surface propulsion is effected by oil engines of 2800 B.H.P., the speed being 15 knots. It is understood that she is armed with one 6in. gun and four tubes, and carries sixty mines.

Japan.

Two large cruisers were launched during the year, the Myoko at Yokosuka on April 16th, and the Nachi at Kure on June 15th. They are the first Japanese cruisers to be designed up to the Treaty limit of 10,000 tons. Two further units of the class, Ashigara and Haguro, are building respectively at Kobe and Nagasaki, and four more have been ordered. The Nachi is 630ft. long on the water line, the breadth being 57ft. She is driven by geared turbines, and the designed speed is 33 knots. Although the armament has been reported as ten 8in. guns, the actual number is probably eight or nine. No other reliable details of these ships have yet come to hand. The 7100-ton cruisers Kako and Furutaka, which were completed in 1926, have already undergone large refits which have altered their appearance. According to Japanese Press reports, it was found necessary to strengthen their hulls after a short period of sea service. In spite of their moderate displacement, each ship mounts six 8in. guns in single, lightly armoured turrets, and the machinery develops 100,000 S.H.P. The combination of speed and gun power is remarkable, but it would be instructive to learn how these vessels behave in heavy weather. Two ships of similar displacement, speed, and armament, the Kinugasa and Aoba, were completed in 1927, but in their case some weight has been saved by pairing the big guns.

Another important ship that went into commission during the year is the aircraft carrier Akagi, first begun in 1920 as a battle-cruiser, and re-designed after the Washington Conference. Dimensions, &c.:—Length, 763ft.; breadth, 92ft.; displacement, 26,900 tons; geared turbines of 131,200 S.H.P. for 28½ knots. Armament:—Ten 8in. guns, four 4·7in. and twelve 4·7in. A.A. In appearance this ship resembles H.M.S. Furious. A second aircraft carrier, the Kaga, originally begun as a battleship, is approaching completion. She is 700ft. long, 100ft. broad, and has turbines of 91,000 S.H.P., giving a speed of 23 knots. Her armament is similar to that of the Akagi.

A number of first-class destroyers were launched during the year. They have a uniform displacement of 1445 tons, a speed of 34 knots, and are armed with four 4·7in. guns and six torpedo tubes. The newest boats, of which twenty-four are on order or projected, will displace 1700 tons and be armed with six 4·7in. guns. Several submarines were launched and others are under construction, the largest approaching 2000 tons.

France.

The launch of the Suffren, the third French cruiser of the "Treaty" type, took place at Brest on May 3rd, exactly twelve months after the keel had been laid. This is believed to constitute a record for speedy construction in France. The Suffren differs slightly from her predecessors, Tourville and Duquesne, the length overall having been reduced from 626½ft. to 607ft., the breadth remaining at 63ft., and the displacement at 10,000 tons. Like other ships of the class, she is equipped with Rateau turbines and Guyot boilers. The designed output is 130,000 S.H.P., and the speed 33 knots. She will have a radius of 5000 miles at a speed of 15 knots. In this vessel the weight allotted to protection has been increased, in order to render the vitals safe from projectiles of medium calibre and air bombs. There are three screws, as against four in the earlier ships. The armament is eight 8in. guns, with smaller weapons, and two catapults are provided for launching aircraft. The Colbert, a sister ship, was begun at Brest on June 12th, and yet another is to be laid down early this year, following the recent passage of the 1927 Estimates, which had been held up by pressure of parliamentary business. Good progress is being made with the construction of the heavy flotilla leaders to which French naval opinion has become so partial. The Bison, Guépard, and Lion will shortly go afloat, three "improved Guépards" are building, and six more are about to be ordered. They are slightly enlarged versions of the "Chacal" class, an appreciation of which appeared in our columns on June 3rd last. The displacement has been increased to 2400 tons and the armament to five 5·5in. guns, the speed remaining at 35½ knots. It deserves to be recorded that these large leaders have been thoroughly tested in long ocean cruises, in the course of which every variety of weather was encountered, and have proved themselves excellent sea boats. The same remark applies to the cruisers of the "Duguay-Trouin" class—which were so greatly admired when they visited Portsmouth last summer—and in somewhat less degree to the "Simoun" group of destroyers, which are rather overburdened with top hamper. Fifteen submarines of various types are now under construction and six projected. The majority are boats with a surface displacement of 1570 tons, but included in the total is a submersible cruiser of 3000 tons, recently begun at Cherbourg. Like the surface vessels, all French submarines completed in recent years have carried out long independent cruises, extending over thousands of miles, in every case with complete success. It is no exaggeration to say that every French naval vessel built since the war is capable of ocean service.

The aircraft carrier Béarn, converted from an unfinished battleship, hoisted the pennant in May. She is 576ft. in length, with a breadth of 89ft., and displaces 21,800 tons. At high speeds—21 knots maximum—propulsion is effected by turbines of 24,000 S.H.P., but when the vessel is cruising or manœuvring, the two outer shafts are turned by reciprocating engines, which develop 15,000 I.H.P. Steam is taken from twelve small-tube boilers, burning oil. The full radius is 6000 miles. The funnel and superstructure are sponsoned out from the hull, thus leaving the flight deck absolutely clear. Forty aeroplanes can be carried. The armament comprises eight 6·1in. guns, fourteen light A.A. pieces, and four torpedo tubes. An "aircraft tender," to be named Commandant Teste, was ordered in May from the Chantiers de la Gironde, Bordeaux. She is to have a displacement of 10,000 tons, a speed of 20 knots, and a main armament of six 5·5in. guns. Judging from the plans, the accommodation for aircraft will be limited, and the value of this type is not very obvious.

Italy.

Following the launch of the Trieste in October, 1926, her sister ship Trento was put afloat at Leghorn on October 4th last. These are the only two 10,000-ton cruisers that Italy has built up to now, and it is possible that no more will be laid down, since the ships of the new programme are to be of 5300 tons only. The two "Trentos" are alone among cruisers designed under Treaty rules in being engined for a speed of 36 knots. The length overall is 642ft., the breadth 67½ft., and the mean draught 19ft. Machinery: Parsons turbines with gearing, twelve Yarrow boilers working at 300 lb. pressure; output, 150,000 S.H.P., for a speed of 36 knots. As these ships mount the standard main armament of eight 8in. guns, besides sixteen 4in. A.A. guns, it is doubtful whether any considerable weight has been left over for protection, even when full allowance is made for the ingenuity of Italian naval constructors. The four cruisers now building are named as follows:—Bande Nere, Colleoni, Da Barbiano, and Da Giussano. They will displace 5300 tons, and be engined for a speed of at least 37 knots. It is understood that six or eight 6in. guns will be mounted in pairs, though triple mountings may possibly be adopted.

The last two units—Azio and Lepanto—of a class of sloop-minelayers were launched during the year. These are vessels of 700 tons, with a speed of 15 knots. Of greater importance are the twelve big destroyers of the "improved Mirabello" class, all of which are now under construction. Displacement, 2000 tons; length, 360ft. overall; speed, 38 knots; armament, six 4·7in. and three smaller guns, six torpedo tubes. Eight smaller destroyers of the "Turbine" class were launched during 1927. They displace 1155 tons and are designed for 36 knots. We learn, however, from the *Rivista Marittima* that this speed was exceeded by a substantial margin on the official trials. During a four-hour run the Turbine attained a mean of 38·9 knots, while the Aquilone averaged 39·5, and at one time actually touched 40·37. If the boats had their normal equipment on board at the time, these results reflect the highest credit on their builders and engineers. Four submarines of 1390 tons were launched in the course of the year, and six boats of 850 tons were ordered.

Germany.

The German Navy Estimates for 1928 included an appropriation for beginning a 10,000-ton armoured vessel to replace one of the obsolete battleships, but this item has since been deleted by the Reichstag. The ship in question was reported to be oil engine driven and designed for the heaviest armament "compatible with Treaty restrictions." The cruiser Königsberg was launched at Wilhelmshaven on March 26th—less than twelve months after being laid down—and a sister ship, Karlsruhe, at Kiel, on August 20th. Although limited to 6000 tons, the designers have contrived to produce a very formidable type of cruising ship. The hull is said to be abnormally light, owing to the employment of electric welding. Geared turbines propel the ship at high speed, 32 knots being the maximum, but at cruising speed she will run on her oil engines, which are capable of driving her at 14½ knots. The total output of the machinery is 65,000 H.P. Nine 6in. guns are mounted in triple turrets, one of which is on the forecastle, the other two aft in echelon. The advantage of this arrangement is that, by yawing a few points, six guns could be trained on a target ahead, while the stern fire is from six guns and the broadside from nine. Two further cruisers of this class are now under construction. The six new destroyers, two of which were launched at Wilhelmshaven on October 12th, displace 800 tons and are engined for 32 knots.

Spain.

The two fine cruisers, Principe Alfonso and Almirante Cervera—7850 tons, 33 knots, eight 6in. guns—have been completed. The trials were very successful, the Principe Alfonso attaining a maximum of 34·7 knots with 83,000 S.H.P. A third vessel of this class, Miguel de Cervantes, is now under construction at Ferrol. The design of these ships was prepared by the late Sir Philip Watts. Three large flotilla leaders and several submarines are in hand at Cartagena. In view of misleading statements in the French Press, to the effect that "German capital and engineering genius" were the factors responsible for the progress of the Spanish Navy, a letter has been circulated by the Advisory Committee of the Sociedad Espanola de Construccion Naval, the Spanish company that has built all the important ships for the Spanish Navy during the last eighteen years: "All these ships have been built in the Government arsenals at Ferrol and Cartagena, and no German capital or engineering genius has contributed in any way to the very successful results which they have obtained. The only foreign capital invested in that company was subscribed by three British firms, who have also acted as technical guarantors—W. G. Armstrong, Whitworth and Co., John Brown and Co., and Vickers Ltd. These firms, between them, have supplied all the drawings and technical information required for the construction of the vessels in question."

Other Navies.

The Netherlands destroyer Evertsen, built by Burgerhout, of Rotterdan, to the designs of Yarrow and Co., Glasgow, ran her official full speed trials on the Clyde last month. Although the vessel had a full load on board, the contract speed of 34 knots was exceeded. The Evertsen is the first of eight destroyers being built in Holland for the national navy. All were designed by Yarrow and Co., and constructed with their technical assistance. Displacement, 1620 tons; machinery, Parsons geared turbines and Yarrow superheated boilers, 31,000 S.H.P.; armament, four 4·7in. guns and six torpedo tubes.

During the year the Argentine Government placed a contract for two cruisers with Italian firms. The first ship, Almirante Brown, is being constructed by Orlando, at Leghorn; the second vessel Veintecinco de Mayo, by Odero, at Sestri Ponente. Displacement, 6800 tons; designed speed, 32 knots; armament, six 7·5in. guns in twin turrets, twelve 4in. A.A. guns, six torpedo tubes. At the same time a contract was awarded to J. Samuel White and Co., of Cowes, for six large flotilla leaders. They will displace about 1800 tons and be armed with five 4·7in. guns. A further Argentine contract was secured by Hawthorn, Leslie and Co., Hebburn-on-Tyne, for two small surveying ships, of 970 tons. They will be driven by Hawthorn-Werkspoor engines.

Six destroyers for the Chilean Navy are under construction at Thornycroft's yard, Southampton, the order having been placed last spring. Displacement, 1090 tons; geared turbines and Thornycroft

boilers, 28,000 S.H.P., for 35 knots; armament, three 4·7in. guns and six tubes, and mine-laying gear. It is understood that the Chilean Government will shortly be placing further important naval contracts.

Two submarines for the Jugo-Slav Government were completed in November. The boats were designed and built by Sir W. G. Armstrong, Whitworth and Co., on the Tyne. They displace 975 tons on the surface and 1164 tons submerged, with corresponding speeds of 15¾ and 10 knots; armed with two 4in. guns and six torpedo tubes.

Aeronautics in 1927.

No. I.

IN the mind of the average member of the population the past year cannot fail to be regarded as an unsatisfactory, if not a disastrous, one for aeronautics. It is undoubtedly true that aviational ambition overreached itself in several instances and resulted in several sensational disasters and failures. That four or five machines succeeded, entirely by good luck, in flying eastwards across the Atlantic is no more a real sign of aeronautical advance than the sad failure of others to repeat the performance is a sign of aeronautical weakness. If ability to fly the Atlantic is to be taken as a symbol of aeronautical advance, then aeronautics has not advanced since 1919, in which year Alcock and Brown first essayed and accomplished the feat. We cannot judge the progress made by aeronautics by performances which depend for their success on the fortune of the weather. That machines can now be built which in favourable circumstances can remain in the air for forty hours or longer is a noteworthy fact, but it can be demonstrated just as convincingly by closed-circuit flights over an aerodrome as by heroic, ill-advised attempts to cross the Atlantic. The perils faced on such transoceanic flights add nothing except advertisement to the significance of the aeronautical achievement.

The real aeronautical progress made during the year can best be estimated by studying the design and construction of the machines produced during the twelve months. Some account of certain typical British machines follows. It is to be inferred from the particulars given that the progress made was real, if not very marked or sensational. The most marked step in advance was probably that taken in the direction of increasing the speed attainable by aircraft. The efforts made in this direction culminated in the production of the three types of racing seaplane which this country entered for the Schneider Trophy race. One of these machines was unfortunately wrecked before the day of the race. Another, as a result of a minor mishap, was compelled to withdraw from the contest after having completed a considerable portion of the set course. Two machines representing the third type alone finished the course, the first of which achieved the record speed of 281·6 miles an hour. This speed was at the time it was set up the highest at which man had ever travelled on any class of machine. Shortly afterwards it was surpassed by an Italian Macchi-Fiat machine with a speed of 296·4 miles an hour. An effort is to be made to regain the speed record for this country, for it is believed that on a straight course the Schneider Trophy winner, the Supermarine Lion S 5 seaplane, is capable of flying faster than 300 miles an hour. The account of the machine, which will be found below, shows that the high speed has been rendered possible by the use of an improved design of engine of increased horse-power, by developments in the construction of metal propellers, and by sound engineering progress in the design and construction of the machine. Some idea of what is involved in designing and flying a machine capable of moving at 300 miles an hour or thereabouts may be gathered from the fact that that speed is equal to the velocity of a body falling in a vacuum after it has descended about 3000ft.

Apart from the achievement of speed, the year witnessed a still further increase in the extent to which metal is displacing wood in the construction of aeroplanes. There is now, we believe, no single British aircraft manufacturing firm which has not experimented with metal construction and which is not prepared to supply machines so constructed. Some firms rarely build wooden machines nowadays, while others are making arrangements to change over completely from wood to metal. It should be noted, however, that other firms, while they have produced successful machines of the "all-metal" type, express themselves cautiously regarding the merits of the system from the commercial as distinct from the technical or aerodynamical point of view. There are undoubtedly many parts of an aeroplane which, unless they are required in large numbers, cannot show anything like the same return when made in metal as when made in wood. For that and other reasons there is growing up a strong body of opinion which is in favour of a composite wood and metal construction for general purposes. Light alloys of the duralumin type are principally favoured by makers of all-metal machines, but there are several firms which hold firmly to steel for the purpose. One great trouble previously experienced with aluminium alloys, particularly in connection with the construction of seaplanes and flying boats, namely, its poor resistance against corrosion by sea water, seems now to have been satisfactorily overcome by the anodic process of treatment. So successful, we infer, has this process been found that floats and hulls of aluminium alloys are now rapidly replacing those of wood, with advantages from the point of view of lightness and strength and freedom from soakage.

From the standpoint of general design, developments during the year, so far as it is permissible to discuss them, followed orthodox lines. Exceptional machines, such as the Hill tailless aeroplane and the Cierva autogiro, the advent of which was a prominent feature of the aeronautical history of 1926, were not at all conspicuous. The two machines named continued to be developed, the autogiro attracting particular attention by achieving a cross-country flight of 30 or 40 miles.

On the service side a tendency to reduce the number of specialised machines was to be observed. At one time, not so many years ago, the policy of the Air Ministry seemed to be to encourage the production of a separate type of machine for every duty which an aeroplane can perform. It will probably never be possible to reduce the number of types required by an air service, having naval, military and independent branches, below half a dozen or so. The fewer the number of types that can be used without serious hurt to the efficiency of the services rendered, the better must it be from the point of view of first cost, training, stores and spares, rapid production and so forth. It is therefore gratifying to note that during the year many firms were engaged on the production of "general purpose" machines to the Air Ministry's requirements. These machines are intended to combine the duties of bombing, reconnaissance, gun spotting and photography, and are sufficiently well armed and are possessed of sufficient speed and manœuvrability to be self-defensive. Even in the case of that particularly specialised type, the torpedo carrier, we notice a tendency to combine its primary duty with others, such as coastal patrol, bombing, and reconnaissance.

On the industrial side there would still appear to have been grounds for complaint against the Air Ministry's policy—a policy which from the administrative side is understandable—of placing orders for machines in small batches separated by considerable intervals of time. It is undoubtedly true that lack of continuity in the receipt of orders increases the cost of the orders when they are received, and, in the periods between the bursts of activity, makes the maintenance of the plant and the retention of the skilled staff difficult and expensive. The official policy is doubtlessly governed by the relatively small peace-time requirements of the Royal Air Force, and by the desire to preserve in being the means for rapid expansion of the manufacturing side, should the necessity arise. That that policy has so far been successful may be inferred from the fact that at the present moment there are five or six first-class firms devoting part at least of their attention to the manufacture of aero-engines and some eighteen well-established undertakings engaged on the manufacture of aeroplanes. Our air force may be smaller than that of other Powers, but it appears to be at least as efficient as any other and is backed by a manufacturing side which is certainly unsurpassed in any other country. The key to the situation in the air lies not in the size of a country's peace-time air force, but chiefly in the facilities which are possessed for the production of high-class aero-engines. In that respect this country is in a most fortunate position. Not only are we able to supply our own needs, but those of other countries. Indeed, the extent to which British engines are now used on foreign aircraft is one of the most satisfactory features of the international air situation.

During the year there were definite signs of a new development in the industrial situation. Previously aircraft manufacturers were practically dependent on the Air Ministry for every order, and while they were encouraged to produce their own designs, they did so primarily in the light of the requirements laid down by the Ministry. Last year there was an increasing output from the works of machines produced as "private ventures" over the design of which, as well as the disposal of the finished machine, the Air Ministry exercised no control, direct or indirect. In permitting the British aircraft industry to build military machines for foreign Governments, the Ministry is but following in the steps of the Admiralty, and will doubtlessly reap the same balance of advantage.

Some Typical British Aeroplanes.

We now turn, as is our custom, to review in some detail the principal products of the British aeronautical industry during the year. As in the past, it has to be made clear that the record is not and cannot be complete and up to date. We are enabled to include in it only those machines which are not on the Air Ministry's "secret list," and in some cases are not allowed to do much more than illustrate and mention the existence of the machines. Even so, the record is, we think, sufficiently detailed to present a fairly just summary of the year's progress in aeronautics.

Westland Aircraft Works.—At the Westland Aircraft Works, Yeovil, the year was one of considerable activity. Two outstanding designs of machine—one civil, the other military—were produced, and were advanced to the production stage. The civil machine, the Westland "Widgeon" Mark III., is a development of the Mark II. type, produced by the firm in 1924. It is, as shown in one of the engravings on page 5, a light, two-seater, parasol-type monoplane. It carries a pilot, passenger and luggage, and is equipped with folding wings to facilitate housing. The engine is a Cirrus Mark II. Machines of this design distinguished themselves during the year at the Bournemouth Air Meeting, in the King's Cup Race, and in the Brisbane Aerial Derby. In the last-named event a standard Widgeon won the speed championship cup with the high speed of 113 m.p.h. The military machine is the Westland "Wapiti," a two-seater general-purpose machine, which we illustrate in a Supplement. This machine carries equipment for bombing, wireless and photography. The engine is a Bristol "Jupiter." The fuselage is of metal construction and is built up from tubes in a way which is claimed to facilitate rapid construction. Particular attention has been paid to the easy inspection of the details. The whole of the cowling from the engine as far back as the pilot's seat can, we are informed, be removed in a few seconds, so as to expose to view the engine, tanks, controls and the front part of the fuselage. The petrol and oil tanks are carried inside the fuselage. One petrol tank feeds by gravity and the other by means of a Vickers wind-driven pump. The main and auxiliary tanks can readily be removed for inspection or repair. The machine has been specially designed to withstand hard service and to fulfil a variety of duties. Particular attention has been given to the balancing of the control surfaces with the object of reducing the fatigue of the pilot. The lateral control is, we understand, especially light and well balanced. The firm is now engaged on the construction of two experimental types of machines for the Air Ministry, concerning which nothing may yet be said. During the year it designed and constructed an improved model of the Hill "Pterodactyl," which will shortly undergo its trial flights.

The Gloster Aircraft Company, Ltd.—Among the machines produced by the Gloster Aircraft Company, of Cheltenham, chief interest will probably be found in the racing seaplane, Gloster IV., which the company constructed for the Schneider Trophy Race at Venice in September. Although this machine met with a slight mishap which prevented it from completing the full course, it definitely showed itself to possess a very high speed. The makers claim, in fact, that it is the fastest *biplane* in the world, and that it is capable of a speed in excess of 300 miles an hour. It is driven by a special geared Napier racing engine, and is equipped with a Gloster propeller of solid forged duralumin. The floats are also of duralumin, treated anodically to resist the effects of sea water. A feature of the machine clearly brought out in the engraving of it given in one of our Supplements, is the remarkable manner in which the engine cowling is faired off into the body and the wings. It will be observed that the cowling of the outer banks of cylinders fairs off into the roots of the upper wings. The cowling of the central block continues along the length of the machine providing, first, the header tank for the cooling water, then the pilot's windscreen, and, finally, blending into the upper tail fin. The body, wings and tail unit are constructed entirely of very thin skins of spruce veneer. The usual fabric covering is wholly eliminated, and the skin is strong enough to take all the air loads coming upon it. All the controls for operating the ailerons, rudder and elevator are housed inside the structure of the machine so as to maintain a minimum head resistance. The cooling of the engine is achieved by means of surface radiators lying on the upper and lower surfaces of both wings. The engine mounting is of high tensile steel tubing, which is completely faired in. In ordinary designs of seaplane, the floats are stayed apart by booms. To avoid the high resistance caused by these booms, they have been replaced in the Gloster IV. by high-tensile steel wires. The wing structure is so arranged that it also forms a part of the float undercarriage bracing. Although the machine is of very high power, it is of quite small dimensions. Its span is only 22ft. 6in.

The Gloster "Goring," which we illustrate on page 5, is another interesting machine produced by the company during the year. It is a two-seater long-distance day bomber, driven by a Bristol "Jupiter" engine. The construction is carried out mainly in wood, with steel fittings, but designs are in hand for making it entirely of metal. The aerofoil used is a slightly modified Joukowski section, which is claimed to give a high lift and exceedingly good results in actual flight. With the ordinary Jupiter engine the machine has the remarkable speed range of from 40 to 140 miles an hour. With a supercharged engine, a speed of 165 miles an hour is, we are informed, attained. The wings are of the single bay type, with inverted-vee struts connecting the top wing to the fuselage. The top wing has a span of 42ft., that of the bottom being considerably smaller. Together they present a total area of 450 square feet. It will be noted that the machine is particularly free from excrescences, and that the whole of the aileron-operating mechanism is contained within the wings, even to the usual external aileron levers. The land

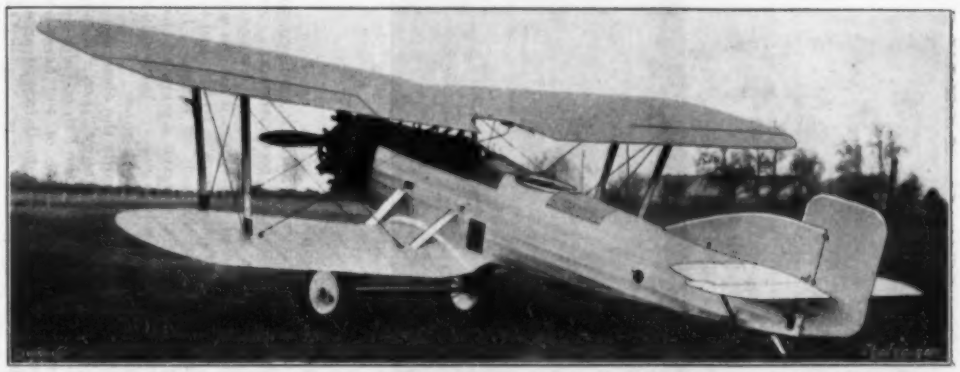
SOME AEROPLANES OF 1927

WESTLAND WIDGEON III. LIGHT TWO-SEATER

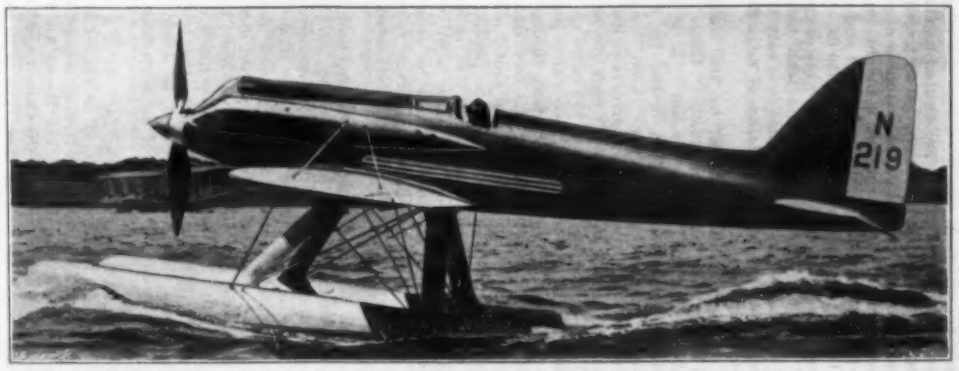
VICKERS VIVID MILITARY TWO-SEATER

A.D.C. NIMBUS MARTINSYDE FIGHTING SCOUT

FAIREY IIIF GENERAL SERVICE AEROPLANE



GLOSTER GORING LONG DISTANCE DAY BOMBER



SUPERMARINE S5 RACING SEAPLANE

undercarriage is interchangeable with floats of duralumin construction, which convert the machine into a seaplane. These floats are treated anodically to preserve them against corrosion, and with ordinary care should, the makers state, last a number of years. As a land machine, the Goring has a weight, empty, of 2800 lb., and with 150 gallons of petrol and other stores, has a fully loaded weight of 5650 lb. As a seaplane its empty weight is 3200 lb., while its useful load is 2450 lb. The range of the land machine exceeds 800 miles. It is stated that it is easy to fly, and that it has the manœuvrability of an ordinary single-seater fighter.

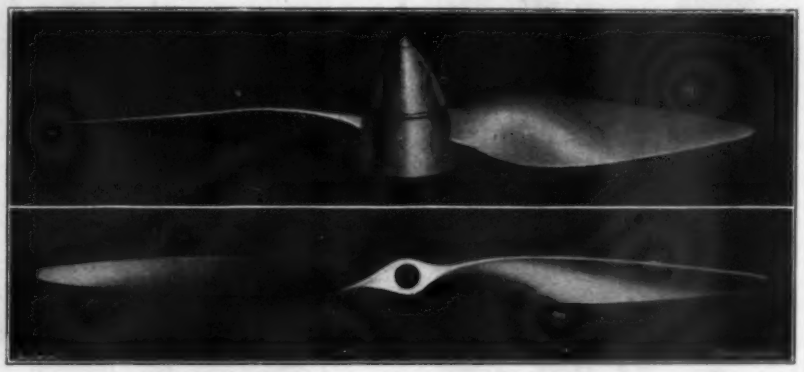
Two other machines produced by the company may be briefly mentioned, the Gloster "Guan" and the Gloster "Goral." The "Guan" is a high-performance single-seater fighter, driven by a 470 horse-power supercharged Napier "Lion" engine. The fuselage is of steel tube construction and the wings are of a special "Gloster" high-lift biplane type. The machine has a speed of 175 miles an hour at 15,000ft. The "Goral" is a two-seater general-purpose machine of steel construction throughout. Its distinguishing feature lies in the fact that the fuselage is made in three detachable units, each of which may, to facilitate transport, be packed into a case of very moderate dimensions. It is driven by a Jupiter engine, but the ease with which the forward unit of the fuselage may be detached, readily permits the installation of other types of engine. The cruising radius under fully loaded conditions is over 750 miles.

During the year the Gloster Company took over the business of the Steel Wing Company, said to be the pioneer undertaking in the steel construction of aircraft. The development of the Gloster Hele-Shaw-Beacham variable pitch propeller is now nearing completion. Static tests have been carried out with the device by the Air Ministry, with, we hear, highly promising results, and air tests will be made in the near future. It is claimed that the invention provides the only device that has succeeded in solving the problem of varying the pitch of an aeroplane propeller in the air.

The Fairey Aviation Company, Ltd.—It is a testimony to the confidence which may be placed in new designs produced by established British aircraft firms that the four machines used by the Royal Air Force in the early part of the year for the Cairo-Cape Town-Cairo flight were the first of their type to be turned out on a production basis. They used were of the new IIIF design made by the Fairey Aviation Company, Ltd., of Hayes, Middlesex. We illustrate the machine as a land machine on page 5 and as a seaplane in a Supplement. The conversion represented can be readily accomplished and has, we are informed, been completed within an hour. The IIIF is a general service aircraft for employment on such duties as bombing, reconnaissance, photography, and gunnery spotting. It can be adapted for commercial purposes, in which capacity it can accommodate three or four passengers in addition to a considerable quantity of luggage or freight. In the military form the machine carries a pilot, an observer—or wireless operator—and a gunner. It resembles the same makers' high-speed day-bomber "Fox," produced two years ago, as regards the cleanness of its lines at the nose end. The Fairey "Fox," it may be recalled, was designed round the Fairey-Felix—otherwise the Curtiss—D 12 engine of 400 horse-power, an engine possessing a very small frontal area. In the IIIF machine the power plant is a Napier "Lion" series V. engine having a compression ratio of 5·8 to 1. A comparison of the two machines suggests that the British engine is at least as adaptable as the engine of American origin to the attainment of a clean nose end. Like other Fairey aircraft, the IIIF has a fuselage consisting of a stiff tubular metal centre portion carrying a detachable welded tube engine mounting at the front and having the rear portion of the fuselage fixed to it behind. The main planes and the undercarriage are entirely supported from the central portion of the fuselage. This arrangement is claimed to give the machine great rigidity, to avoid distortion when the planes are folded, and to facilitate repairs and replacements. The engine is started by means of a hand crank at either side of the fuselage. A retractable radiator is mounted behind and below the engine and can be lowered or raised by the pilot to suit the conditions under which he is flying. The fuel supply system is worthy of note. The petrol is delivered to the carburetters by an engine-driven pump. On its way it passes through a hand pump of special design, which, should the necessity arise, can be operated by the pilot. Tank capacity is provided for 124 gallons of petrol and 9 gallons of oil. The main planes are of wooden construction and are fitted with the Fairey patented variable camber gear. They can be readily folded, in which condition the machine has an overall width of only 14ft. 6in. In the seaplane variation the floats are of duralumin and have a capacity of 193 cubic feet each. Transverse tubes are provided in the floats to accommodate the axles of the detachable wheels used when the machine is being handled on land. A feature of the flying controls in the pilot's cockpit is the fact that they are all fitted with cam quadrants, whereby, over the range of maximum operation, the movement of the pilot's control can be increased relatively to that of the surfaces controlled. This feature enables the pilot considerably to reduce the fatigue caused by flying the machine full out for prolonged periods.

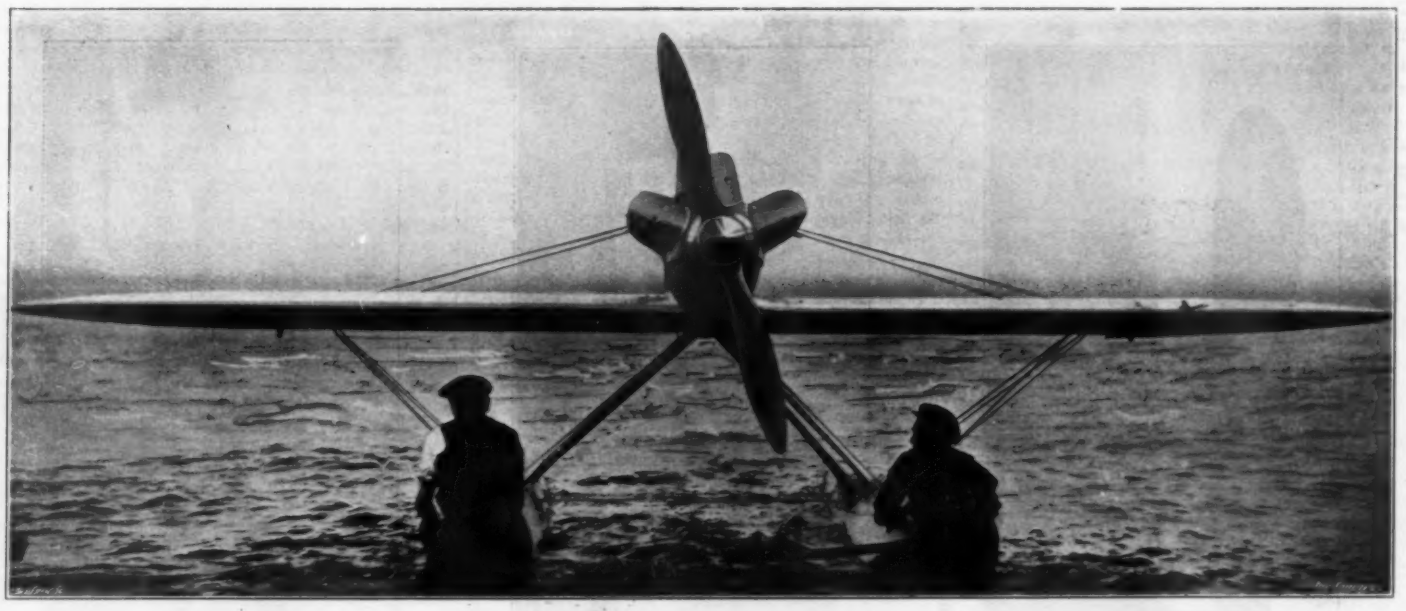
The Fairey "Fox" day-bomber, already referred to, was described and illustrated in our review of aeronautics in 1925. It attracted undiminished attention during the year, particularly in connection with the air manœuvres carried out over the London area in the summer. In the opinion of some it demonstrated that the day-bomber had made greater relative progress than the fighter called upon to repel its attack, and that it would result in a speeding up of the development of aircraft of defence.

The Fairey-Reed metal airscrew continued to be extensively employed during the year. The two Supermarine seaplanes which alone finished the course set for the Schneider Trophy race at Venice were both fitted with airscrews of this design. In an accompanying engraving we illustrate the screw as fitted to the Schneider race machines. Below it we reproduce a photograph of a new type of Fairey-Reed airscrew. Like the earlier design, it is made from a forging or rolled strip of duralumin or other light alloy, the pitch of the blades being given by twisting them after they have been brought to the required profile. In the air the centrifugal and air forces are made to balance each other in such a way that the blades find their own position of equilibrium at each speed and are subjected almost entirely to pure tension. In the new design the screw, it is claimed, is absolutely silent when running. That result represents a significant step in advance. Previously little has been done to silence aircraft engines, because it was recognised that much, if not most, of the noise emitted by an aeroplane comes not from the engine, but from the propeller.



FAIREY-REED SCHNEIDER TROPHY METAL AIRSCREW
FAIREY-REED SILENT METAL AIRSCREW

The Supermarine Aviation Works, Ltd.—The Woolston Works of the Supermarine Company were extensively employed during the year on the construction of Southampton flying boats, so much so that the firm had to take over the seaplane sheds at the Hythe base in order to increase its production facilities. The Southampton design was illustrated and described in our review of aeronautics last year. In February last year the firm delivered its first Southampton flying boat built with a metal hull and metal wing tip floats. On October 19th four of these metal-hulled boats, each carrying a crew of four, left Plymouth on a 25,000-mile flight to Australia and the Far East and arrived safely at Karachi on November 18th. The flight is now being continued.



FRONT VIEW OF SUPERMARINE S 5 RACING SEAPLANE

In the eyes of the public at least, the outstanding production of the Supermarine Works during the year was the S 5 racing seaplane, by means of which this country once again succeeded in gaining the Schneider Trophy. This interesting and remarkable machine is illustrated herewith and on page 5. It is one of the high-speed seaplanes ordered by the Air Ministry in continuation of its policy of experimenting with this type of aircraft. It was designed and constructed by the Supermarine Company and is a development of the firm's S 4 machine, which in 1925 set up a world's record speed for sea-

planes. It may be described as a low-wing semi-cantilever monoplane with twin floats. The fuselage has probably less cross-sectional area than that of any machine previously built. The cross section is, in fact, based on the minimum requirements for the accommodation of a pilot. It is of very great interest to learn that, thanks to recent developments in the design of the racing Napier "Lion" engine, the designer of the aircraft, having fixed the fuselage cross section just to accommodate the pilot's body, did not find it necessary to increase the section to suit the engine. The centre section of the fuselage is of monocoque form in duralumin. Almost the whole stress in this form of construction is taken by the shell of the body, the hoops and longitudinal stringers acting mainly as local stiffening members. With a fuselage of such small cross section it will be realised that a crucial point is the means adopted for extending the monocoque central section into the engine mounting. The engine mounting in the S 5 is a cantilevered extension to the body. The shell of the body is therefore called upon to withstand the gravity and torque loads of the engine and any vibration that may occur. The wings and chassis struts are attached to two stiff frames in the fuselage, and at these points also a nice engineering problem was encountered in securing a gradual change of strength in adjacent cross sections. The wings are of wooden construction with two main spars stiffened against torsion by built-in drag members. The external bracing of the wings consists on the upper surface of two streamline wires running from about the mid-points of the main spars of each wing to the top of the front main fuselage frame. On the underside two streamline wires pass similarly from the spars to the floats. The radiators form parts of the wings. Their surfaces are entirely flat, and to an unsuspecting observer appear as part of the normal wing covering. The cooling effect is stated to be excellent. The radiators add nothing to the resistance of the machine, unlike the radiators with corrugated external surfaces previously fitted into the wings of racing aircraft.

The floats are of duralumin anodically treated to resist the corrosive action of sea water. Each float is attached to the fuselage by two streamline struts braced fore and aft by wires. Four lateral and diagonal bracing wires maintain the floats in position relatively to each other. The centre portion of the starboard float is constructed to carry the petrol supply. Had the petrol been carried in the body, as is usual, it would have been necessary considerably to increase the cross section of the fuselage. The weight of the petrol in the starboard float exerts a moment on the fuselage about its longitudinal centre line. This moment was deliberately increased by slightly offsetting the chassis relatively to the fuselage. The result is that the petrol moment acts in resistance of the engine torque. It is stated that as a consequence of this arrangement pilots flying the machine find its balance so perfect that when it is "full out" they do not require to use the ailerons to counteract the engine torque. The petrol from the float tank is drawn up by an engine-driven pump and delivered into a small gravity feed tank in the fairing of the starboard engine cylinder block. An overflow conducts any excess from the gravity tank back into the main tank in the float. The cooling water is also circulated by an engine-driven pump, and in the fairing aft of the central cylinder block there is a header tank for the water. The cooling of the lubricating oil is effected by means of coolers running along the after portion of the fuselage.

The pilot sits with his head in line with the central engine cylinder block. The top side of the rear portion of the fuselage is shaped to fit over his shoulders. The gap through which the pilot's head projects is very small, and for about 18in. in front of it the fairing is formed with Triplex glass sides and top. At high speeds the pilot can therefore see ahead through the glass without moving his head outside the fairing. In flight the heat inside the body tends to become troublesome, while in addition a certain amount of exhaust gas always finds its way into the cockpit. In order that the conditions may not become unbearable for the pilot, fresh air ducts are provided at several places round the cockpit.

The design was produced with a view to fitting the machine either with a direct-driven or a gear-driven propeller, the engines in both cases being Napier "Lions." In the event it was found that the geared engine gave the machine a speed nearly 10 miles an hour in excess of that given by the direct-drive engine. A very large number of duralumin airscrews were made for the machine by the Fairey Aviation Company, Ltd., and the merits of each were determined on test flights. The Schneider Trophy race was won at a speed of 281·6 miles per hour. The only other machine to finish the course was a second Supermarine S 5. The winner's speed was at the time of the race the highest at which any man had ever flown. High as it is, there is reason to believe that on a straight course the S 5 could excel it and even go beyond the 300 miles an hour mark.

A.D.C. Aircraft, Ltd.—The Croydon works of the A.D.C. Company continued to produce the 30/80 H.P. "Cirrus" Mark II. light aeroplane engine and the 300/330 H.P. "Nimbus" engine, both of which were illustrated in our review twelve months ago. For the smaller engine, especially, a remarkable demand, we are told, was experienced, particularly for machines for light aeroplane clubs. We hear that the company's design staff may be expected shortly to produce new types of air-cooled engines, including one with eight cylinders arranged *en vee*. The company has now acquired the name, manufacturing rights and goodwill of the late Martinsyde Company, and during the year produced the Nimbus-Martinsyde single-seater scout, of which we give an illustration on page 5, This machine is intended to fulfil all the requirements expected of a first-class single-seater fighter of high performance. It maintains generally the Martinsyde characteristics, particularly in the strong development of streamlining. Its span is 32ft. 9in., its length 26ft. 10in., and its height 9ft. 6in. The total weight amounts to 2665 lb., of which 321 lb. represents the fuel and oil carried, 170 lb. the pilot, and 160 lb. the military equipment. The machine has a maximum speed of 150 miles an hour, a cruising speed of 131 miles, and a landing speed of 50 miles. It can climb to 10,000ft. in 7½ minutes, to 15,000ft. in 14 minutes, and to 20,000ft. in 25 minutes. Its service ceiling is 23,500ft.

Vickers Ltd.—The outstanding features of the year's activities at the Weybridge Works of Vickers Ltd. were the developments made in metal construction, as applied both to new designs and to those originally made largely or wholly in wood. The metal chiefly employed for the purpose was duralumin, as made by James Booth and Co., Ltd. Of the new designs turned out, we may speak freely of the "Valiant," a two-seater military general-service machine, fitted with a Bristol engine, which was produced as a private venture for sale to foreign Governments. It is illustrated in one of our Supplements. It is built entirely of duralumin and steel, except for the fabric coverings of the wings and control surfaces and for a portion of the fuselage covering. The engine mounting is a detachable unit in which a fireproof bulkhead is embodied. The forward portion of the fuselage framework is built of steel tubing, the rear portion being of duralumin tubing. From the engine mounting to the observer's cockpit the fuselage is covered with two-ply spruce, built to shape on formers and clothed with fabric. This construction is held to give a clean surface and the rigidity and strength in the neighbourhood of the cockpits which is so desirable. The wing spars and ribs are of duralumin, while the interplane struts are of steel, of streamline section. Petrol is carried in gravity-feed tanks situated in the upper planes. The lubricating oil is contained in a tank situated aft of the fireproof bulkhead, and close at hand outside the fuselage is a Vickers-Pott oil cooler. All the important bearings throughout the machine are lubricated on the Tecalemit grease gun system. Approximately at the centre of gravity of the machine there is a large bay in the fuselage, having a capacity of 17 cubic feet, wherein there are housed a spare landing wheel and other spares and sundries. This compartment is metal-lined. In addition to the standard armament and service equipment accommodation is provided on the machine for tool kits, rations, spare tail skid and 19 gallons of drinking water. The machine has a weight, empty, of 2943 lb., and a useful load of 2607 lb. It can fly at 127 m.p.h. at 9840ft., and has a minimum speed of 51 m.p.h. It can climb to the height named in 18½ min.

Another machine of Messrs. Vickers' construction which we illustrate on page 5 is the "Vivid," a two-seater military machine of all-metal construction, except for the fabric convering. This machine has completed constructor's trials, both as a land plane and as a seaplane. The engine is a Napier "Lion" V*a*, developing 535 H.P. In the land form the machine has a total weight of 5160 lb., of which 1633 lb. represents the useful load. It has a maximum speed of 132 m.p.h., and a minimum speed of 49 m.p.h. It can climb to 14,760ft. in 19½ min. In the seaplane form the total weight is increased to 5550 lb., and the useful load reduced to 1531 lb. The maximum speed is reduced to 121 m.p.h. and the minimum is increased to 51 m.p.h. Its rate of climbing is also affected, the climb to 14,760ft. being increased to 24·5 min. Features of the design revealed in our illustration are the petrol tanks worked into the upper wings, and the radiator cowled beneath the engine.

The Vickers "Vixen" two-seater general-purpose military machine, which we illustrated two years ago, was originally produced with a Napier "Lion" engine of 450 H.P., and had a maximum speed of 136 m.p.h. During the year just closed it was produced with a Rolls-Royce "Condor" engine developing up to 800 H.P. With this increase in its power equipment, it is expected to attain the remarkable speed of 146 m.p.h. at 19,680ft. and to climb to that height in 19 min. It has a total weight of 5550 lb., and a useful load of 1557 lb. As in the "Vivid," the boss of the tractor screw is shrouded in a large cone, and the radiator is cowled beneath the engine.

The advanced training machine "Vendace," which we illustrated a year ago, has also had its power increased by fitting it with an A.D.C. Nimbus engine of 335 H.P., in place of the Rolls-Royce "Falcon" engine of 290 H.P., with which it was originally equipped. The twin-engined night bomber "Virginia" and the "Victoria" troop carrier continued to be made for the Air Ministry during the year. The "Virginia" was built experimentally with duralumin construction for the wings and fuselage, in place of the original wood, and there was a resulting structural weight saving of several hundreds of pounds. In addition, its defensive and offensive capacities were developed.

(To be continued.)

Bridge Engineering in 1927.

New English Bridge at Shrewsbury.

SHREWSBURY stands in the very bight of a great bend of the river Severn. Two famous bridges cross the limbs of the bight; on one side the Welsh and on the other the English bridge. The latter was designed by John Gwynne, R.A., a native of Shrewsbury, and completed in 1769. It carried the main road, on the English side, across the river on seven semi-circular arches built of Grinshill stone, and was crowned by a handsome stone parapet. It was a very fine bridge, 400ft. long, but suffered from two serious defects. It was far too narrow, only 23½ft. between the balustrades, and the rise to its centre was far too steep. As a matter of fact, it was composed of two practically flat ramps meeting in the centre at a point 10ft. above that of the abutments. It became imperative either to replace it by a modern structure or to modify it. After very careful consideration an ingenious scheme, proposed by Mr. A. W. Ward, A.M. Inst. C.E., the borough surveyor, was adopted, and its successful completion is quite a notable event in the history of English bridges. Mr. Ward entirely demolished Gwynne's bridge, carefully marking, as he did so, every stone. He then removed the old wooden grillage upon which the piers were founded, and replaced them by solid concrete foundations carried down to good clay. On these new bases he built new piers, wider than the old, and upon them re-erected the old bridge, but with new work introduced in the centre, so that the width was increased to 50ft. between the parapets, 30ft. being carriageway. At the same time he omitted some of the stones under all the arches except those at each end, thus lowering the crown of the central arch by 5ft., and reducing the ramps to reasonable proportions. The result is wonderfully successful. The faces of the bridge are just as they were, and as it still has two straight ramps it retains the characteristic of Gwynne's bridge. Indeed, it may be doubted if any one seeing it and not knowing that a change had been made would notice any material difference. At the south-eastern end the road makes a sharp turn to the Ludlow-road, and to accommodate it Mr. Ward took the bold course of splaying the last span on that side by 12ft. He desired, however, to preserve the old contour of the arch and to use the old voussoirs. Hence he reconstructed the face in its original form, but at an angle to the bridge, and then built in a segment to connect it with the straight arch of the remainder. It is a very striking device, admirably carried out. Mr. Howard Humphreys, M. Inst. C.E., acted as consulting engineer; the principal contractors were Muirhead, Macdonald, Wilson and Co., Ltd., of Birmingham; and London. The bridge was opened on October 26th.

The Newcastle-Gateshead Bridge.

Work proceeded satisfactorily during the year with the erection of the New Road Bridge, which is being built over the Tyne between Newcastle and Gateshead. The abutment piers were got in and the erection of the steel span begun. The arch, when completed, will be the largest in the country. The span from pin to pin is 531ft., and the rise is 170ft. The roadway is to be at a height of 93ft. above high water level, and there will be clear head room for shipping of 84ft. The gradient of the approach on the Newcastle side is 1 in 66·4, and on the Gateshead side 1 in 99·5. The width of the carriageway is to be 38ft., and each footway is to be 9ft. wide. The carriageway will include a double tramway track by which the tramway systems on both sides of the river will be linked up. In addition to the standard Ministry of Transport loading, an exceptional load of 100 tons on four wheels has been allowed for in anticipation of very heavy traffic being met with. The arch is to consist of two crescent-shaped ribs at 45ft. centres, each rib being composed of upper and lower looms of parabolic outline, with single bracing of the Warren type. The depth between the booms, at the centre, is to be 20ft. 3in. The ribs are to be connected by lateral and sway bracing, the lateral bracing being in "K" formation. Towards the abutments the roadway is to be carried on columns supported on the upper booms of the ribs, while in the centre it is to be supported by hangers from the lower booms. The approaches on each side of the arch are carried by continuous girders at 34ft. centres, supported on steel columns, the spans varying from 100ft. to 154ft. Earth approaches, retained by concrete walls partly masonry faced, have been provided on each approach between existing street surfaces and the continuous girder spans. On both sides this construction extends for approximately 200ft.

Sydney Harbour Bridge.

Considerable progress was made with the work of erecting the Sydney Harbour Bridge, the contract

for which was entrusted, in 1924, to Dorman, Long and Co., Ltd. This bridge will have a total length, including the approach spans, of 3770ft., its principal feature being a single arch span across the harbour, having a length of 1650ft., and giving a clear headroom to shipping of 170ft. at high water. From the water level to the top of the arch the height will be 450ft. Several of the approach spans on the north and south sides of the harbour were completed during the year. Work on the huge abutment towers for the main arch span progressed satisfactorily. These towers of concrete faced with granite measure 222ft. by 162ft. at their bases, and when finished will have a height of 285ft. At their bases the main bearings for the arch ribs were placed in position. Each of these bearings weighs 296 tons, and will take an estimated total thrust of 20,000 tons. The diameter of the main bearing pins is 14½in. For the erection of the main arch span two travelling crane equipments, one working from the north and the other from the south shore, will be used. These equipments will move out on the top of the arch ribs as the work of erection proceeds, and will virtually lay their own track in mid air until the two parts of the bridge join up at the centre. A fully illustrated description of the erecting crane equipment appeared in our issue of October 28th, 1927.

Lifting a Bridge in Northern Rhodesia.

An interesting feat which was completed by the end of March was the lifting of the Kafue Railway Bridge in Northern Rhodesia. This structure, which is 1398ft. long, and comprises thirteen spans, weighs 910 tons. It was decided to raise it so as to lift it well above the river Kafue and to rid it from the annual threat of being damaged by floods. The height through which it was lifted was 5ft. The work was accomplished in six stages of 10in. each, and the whole of the bridge was raised in one piece by means of twenty-eight hydraulic jacks. As the bridge rose wooden wedges were inserted and pressed home so as to take the weight from the jacks. When a 10in. lift had been effected a concrete block was swung into position on each pier and cemented in place. The raising of the approaches proceeded concurrently with the raising of the bridge, and after each 10in. lift trains were allowed to pass over the bridge—crawling at first until it was made certain that everything was safe. The operations necessitated the use of 1000 concrete blocks and 1800 bags of cement, and their cost is said to have been £7000. During the whole process of lifting no mishap of any kind took place, and there was only one departure from schedule when, for the fourth lift, heavy rain caused a postponement from the appointed day until the next. The scheme was designed and carried out under the direction of Mr. Rigley, the bridge engineer of the Mashonaland and Rhodesian Railway.

A Noteworthy Bridge Reconstruction.

A noteworthy bridge reconstruction feat was performed towards the end of the year on the London and North-Eastern main line from King's Cross to the North. The old bridge over the Great North Road at Grantham was considered inadequate to support the increased weight of traffic, and it was decided to replace it by a single span steel bridge, composed of a heavy built-up trough girder and two parapet girders. The order to proceed with the work was received on October 20th. Five weeks later, on Sunday, November 27th, the first half of the old bridge was removed and the first half of the new bridge erected in its place. The second half of the work was begun and completed on the following Sunday. During each of the two days' operations some 40 tons of old cast iron girders and a considerable amount of brickwork in jack arches had to be removed before the new girders could be fixed in position. Not only was the bridge manufactured and erected—by John Butler and Co., Ltd., of Leeds—within six weeks of the order being received, but on both erection days the line was opened for traffic before the time scheduled by the railway engineers.

Strengthening a Railway Bridge.

The strengthening of a bridge over the river Don between Tinsley and Rotherham, which was built about 60 years ago, and which carries the L. & N.E. Railway Company's main line from Sheffield to Doncaster, Hull and Grimsby, was satisfactorily completed. The work had occupied nearly two years. The bridge has two spans of 100ft. each, measured on the skew, the angle of skew being 45 deg. The superstructure is of the through type, and consists of four wrought iron main girders, each 106ft. long, 7ft. 8in. deep, 2ft. 6in. wide, and spaced 27ft. 6in. clear apart, with cross girders, of which there are forty of full length, spaced 4ft. 8in. apart. The old cross girders were of wrought iron and of the plate type, 2ft. deep and 12in. wide. As there was considerable vibration and oscillation during the passage of traffic over the bridge, and also deterioration in the webs and flanges of the cross girders, and, further, to provide for the increased stresses due to the modern heavy locomotives now in use, it became necessary to strengthen the bridge.

As the main girders were, generally, in good condition, they were allowed to remain. In order, however, to reduce the stresses in them and also those on the two cast iron cylinders, which supported the old bridge in the centre of the river—some settlement having taken place on the bearing plate on the top of the southernmost cylinder—it was decided to halve the spans by placing an additional support under the centre of each box girder. These new supports each consist of two brick piers built one on each side, and clear of the existing bridge, which carry a steel cell girder upon which the main box girders are supported on rocker bearings. In addition, forty of the old cross girders were replaced by new steel girders securely attached to the main box girders, and a new timber deck flooring provided with fixed roads has been put in, all ballast being eliminated from the bridge. As strengthened, the bridge is estimated to be sufficiently strong to carry the British Standard unit loading of 20 units, the material being stressed in accordance with the British Standard specification for girder bridges.

Various Bridge Items.

Accident to a Mississippi River Bridge.—On September 6th a serious erection accident interrupted the construction of a bridge across the Mississippi at Louisiana, Mo. In an account which was published by our contemporary, *Engineering News-Record*, it was explained that erection was in progress from the western, or Missouri, end. The semi-cantilever method of erection was being used. One span had been swung into position and riveting was in progress. The second span was about two-thirds erected, when the two temporary bents carrying it gave way and the span fell into the river. It was 314ft. in length. Fortunately, the loss of life was not great, being limited to that of one man.

A Wide Span Concrete Bridge.—A concrete bridge is under construction across Dog Creek on the Pacific Highway, about 40 miles north of Redding, California, that has a 235ft. open spandrel arch span, the roadway being 125ft. above the stream bed.

New Bridge at Tientsin.—A new bridge of the Scherzer type was put into service at Tientsin. It Crosses the Haiho and has a width for traffic of 58ft., as compared with the 28ft. of an old bridge near to which it has been built. Similarly, it affords a clear opening of 140ft. for river traffic as compared with the 57ft. of the old bridge. The moving span is operated by four electric motors, each of 65 horse-power.

Moving a Large Bridge.—The moving of a large bridge across the Allegheny River at Pittsburgh was carried out during the summer. The bridge consists of two spans, each 440ft. long, 44ft. wide, 80ft. high, and each weighing 1600 tons. As the bridge was not strong enough to carry modern loads, it was decided, since it was considered that the superstructure would still give good service for lighter loads, to move it some miles downstream and to re-erect it over the Ohio River. The work was accomplished by floating each span, integrally, on scows. The first span was lowered on to four steel barges, each of 1000 tons capacity, fastened together in pairs and placed longitudinally with the span. Blocking was placed on steel girders that fastened the barges together, at each panel point of the span, so that the latter rested at 42 points. In this nest of blocking there were set screw jacks of 40 tons capacity, to be used in relieving tension in the top chords. After the span had been loaded on to the barges—an operation which only occupied one day—it was moved endways, so as to clear the centre pier. It was then swung downstream and taken charge of by tugs. As there was not sufficient clearance under bridges which had to be passed on its way to its destination, it was necessary to take off a portion of the top chord.

Motor Vessels and Marine Oil Engines in 1927.

THE paramount importance of maintaining steady progress in the design and construction of motor vessels and marine oil engines must be acknowledged, when it is recalled that during the past year the total amount of motor ship tonnage under construction greatly exceeded that of steamships. At the end of 1927 about one third the world's motor shipping was British owned and operated, while most of its tonnage was built and engined in British yards. In the face of such facts it is only fitting that the number of motor vessels and marine oil engines constructed in Great Britain and Ireland should each year show a steady increase.

From the totals which are given in Table I., it will be observed that the increases in the number of vessels built, the total gross tonnage, and the indicated horse-power of the propelling machinery, which were noticeable features of the output totals of the last seven years, with the exception of setbacks in 1923 and 1926, were again observable in the year just ended. The increase was not confined to any one class of ship, for the progress made by the motor vessel was very marked in all classes of service. Last year saw the commissioning of larger motor passenger liners, faster passenger and cargo ships, and a larger number of motor tankers, besides the completion of various ships designed for special trading routes.

In Table II. we give particulars of the majority of the motor vessels which were built or engined in Great Britain last year. That number would have been still larger if it had been possible to take into account several vessels which were launched late in the year, and will be ready for trial within the next two months. Taken on the whole, the vessels are perhaps smaller than those of some of previous years, and there is a very large proportion of oil tankers, which is not surprising, when it is remembered that such vessels constitute almost one-third of all the motor ships afloat. The particulars given in Table II. also show a marked degree of standardisation, both in hulls and propelling machinery.

The Large Motor Passenger Liner.

Viewed in the light of the experience gained in the operation of large passenger motor liners during the past year, there is now no doubt that marine oil engine builders can put forward propelling machinery which will meet the power requirements of even the largest ocean-going liner. In this connection engines have been mentioned which would each have twelve cylinders, and with a quadruple shaft arrangement would be designed to develop 15,000 to 25,000 S.H.P. per shaft, or a total of 60,000 to 100,000 S.H.P. No orders, however, were placed for such super-motor passenger liners during the year just ended. One large liner, namely, the Royal Mail Steam Packet Company's motor vessel Alcantara calls for special mention. Although completed in 1926, the Alcantara did not make her maiden voyage until early in 1927, and she was fully described in THE ENGINEER of February 25th. A sister ship to the Asturias of 1925, she is propelled by twin-screw, eight-cylinder double-acting four-cycle motors of the Harland B & W type. They have a rated output of 15,000 S.H.P., and give a sea speed of about 16½ knots. Both these vessels have proved very popular in the South American service of the R.M.S.P. Line.

A significant indication of the economy and success achieved with a vessel of an almost similar type, the Carnarvon Castle, of the Union-Castle Mail Steamship Company, Ltd., is the placing with Harland and Wolff, Ltd., of an order for a sister ship of 20,000 gross tons, which is now under construction. Work in progress at Belfast also includes a 26,000-ton White Star Liner and four 15,000-ton motor vessels for the Nelson Line. A similar ship will be built at Greenock. During the year large passenger liners were completed for Italian—see Fig. 1, and to-day's special Supplement—and Swedish owners, but they are referred to more particularly in that section of this article which deals with progress made on the Continent.

Double-acting Engines.

The vessels at sea mentioned in the preceding paragraph are all propelled by double-acting four-cycle oil engines of the Harland B & W type, and similar machinery will be supplied for the new large liners now under construction. This type of engine has shown itself suitable for the highest powers, with great economy in fuel. In this connection it may be noted that the fuel used for all purposes in the 18,000-ton motor liner Gripsholm was on recent voyage 55 tons per day of twenty-four hours, while that for the 22,000-ton R.M.S.P. Liner Alcantara is less than 70 tons.

Another type of double-acting oil engine, also of the four-cycle type, which appears in the returns of the year, is that installed for the series of ten motor oil tankers constructed in Great Britain and Holland for the Anglo-Saxon Petroleum Company, Ltd. The British engines were built at the works of the North-Eastern Marine Engineering Company, Limited, and at Hawthorn, Leslie and Co.'s works, in collaboration with the Werkspoor Engine Works of Amsterdam, and Mr. C. Zulver, the owners' chief superintendent-engineer. They are six-cylinder units, with a cylinder bore of 820 mm. and a stroke of 1500 mm., and are designed for an output of 4000 S.H.P., at 95 r.p.m. All of them are furnished with a combined air inlet and exhaust valve of the Lugt-Zulver type, which is built into cylinder heads of symmetrical design. A description of that special type of valve gear was given in THE ENGINEER of February 12th, 1926.

Towards the close of the year extended reliability

TABLE I.—*Vessels of 1000 Gross Tons and Upwards Fitted with Marine Oil Engines and Completed in Great Britain and Ireland during the Years 1920–1927 Inclusive.*

Year	1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.
Number of vessels completed	7	15	17	14	43	44	30	40
Total gross tons	53,407	83,980	114,527	78,862	231,764	282,325	212,063	228,751
Total I.H.P. of propelling machinery	31,140	42,860	69,820	49,137	145,130	180,125	160,460	174,905

TABLE II.—MOTOR VESSELS AND MARINE OIL ENGINES OF 1927

Name of motor vessel.	Owners.	Shipbuilder.	Hull particulars. Length B.P.	Breadth m'lded.	Depth m'lded.	Gross tonn'ge	Type of propelling machinery.	Main engine particulars. Cyl. bore.	Piston stroke.	R.p.m.	Total I.H.P.	Total S.H.P.	Number and kW size auxiliary generator sets
			Feet.	Feet.	Feet.								
*Agatha	Anglo-Saxon Petroleum Co., Ltd.	Harland and Wolff, Ltd.	300	50	19·25	3,120	Two 6-cyl., 4-cycle, S.A. Harland-B. and W.	500 mm.	900 mm.	150	2,385	1,700	Electric and steam
*Augustina	" " "	Swan, Hunter and Wigham Richardson	300	50	19·25	3,120	Two 6-cyl., 4-cycle, S.A. Hawthorn-Werkspoor	460 mm.	900 mm.	150	2,100	1,500	Electric and steam
*Aletta	" " "	Caledon Shipbuilding and Engineering Co., Ltd.	300	50	19·25	3,120	Two 6-cyl., 4-cycle, S.A. Werkspoor	460 mm.	900 mm.	150	1,900	1,400	Electric and steam
*Bullmouth	" " "	Hawthorn, Leslie and Co., Ltd.	440	50	32·75	7,540	One 6-cyl., 4-cycle, D.A., Hawthorn-Werkspoor	820 mm.	1,500 mm.	95	5,000	4,000	Electric and steam
*Bulesses	" " "	Hawthorn, Leslie and Co. Ltd.	"	"	"	"	" "	"	"	"	"	"	"
*Marpessa	" "	Rotterdam Dry Dock	"	"	"	"	North Eastern-Werskpoor	"	"	"	"	"	"
*Patella	" " "	Palmer's Shipbuilding and Iron Co., Ltd.	"	"	"	"	" "	"	"	"	"	"	"
*Pecten	" " "	" " "	"	"	"	"	" "	"	"	"	"	"	"
*Trocas	" " "	Rotterdam Dry Dock Co.	"	"	"	"	" "	"	"	"	"	"	"
*Paua	" " "	Harland and Wolff, Ltd.	205	36	15	1,260	One 6-cyl., 4-cycle, S.A. Harland-B. and W.	500 mm.	900 mm.	130	1,055	700	Electric and steam
*Paula	" " "	" " " "	305	50	15	2,770	Two 6-cyl., 4-cycle, S.A. Harland-B. and W.	500 mm.	700 mm.	160	1,935	1,350	Electric and steam
*Petronella	" " "	" " "	"	"	"	"	" "	"	"	"	"	"	"
Bermuda	Bermuda and West Indies Steamship Co., Ltd.	Workman, Clark and Co., Ltd.	530	74	45	19,170	Four 4-cyl., 2-cycle, opposed-piston Doxford (Two piston strokes.)	600 mm.	760 mm. 1040 mm.	118	15,000	13,500	4, 300 kW
*British Faith	British Tanker Co., Ltd.	Caledon Shipbuilding and Engineering Co., Ltd.	440	56·9	33·9	6,980	One 8-cyl., 4-cycle, S.A., Burmeister and Wain	740 mm.	1,500 mm.	98	3,800	2,700	Electric and steam
*British Loyalty	" " " "	Palmer's Shipbuilding and Iron Co., Ltd.	440	56·9	33·9	6,980	One 6-cyl., 2-cycle, S.A., Sulzer	680 mm.	1,200 mm.	100	3,800	2,700	Electric and steam
*British Union	" " " " "	Swan, Hunter and Wigham Richardson, Ltd.	440	56·9	33·9	6,952	One 6-cyl., 2-cycle, S.A., Wallsend-Sulzer	680 mm.	1,200 mm.	95	3,700	2,650	2, 42 kW
*British Valour	" " " " "	Lithgows, Ltd.	440	56·9	33·9	6,950	One 8-cyl., 4-cycle, S.A., Kincaid-Harland-B. & W.	740 mm.	1,500 mm.	98	3,800	2,700	2, 65 kW
*Buesten	Tonsberg Rederi	Barclay, Curle and Co., Ltd.	400	52·5	29·25	5,187	One 3-cyl., 2-cycle, Opposed-piston Barclay Doxford	580 mm.	2,320 comb'd	80	2,200	2,000	Two 21 kW and steam
Cheshire	Bibby Steamship Co., Ltd.	Fairfield S. and E. Co., Ltd.	482	60	36·25	9,130	Two 8-cyl., 2-cycle, S.A., Fairfield-Sulzer	28 in.	39 in.	110	9,600	7,700	Three 225 kW
Daru	Elder, Dempster and Co., Ltd.	Arch McMillan and Co., Ltd.	355	45	33·5	3,790	One 6-cyl., 4-cycle, S.A., Harland-B. and W.	740 mm.	1,500 mm.	86	2,570	1,940	3, 65 kW
Dunkwa	" " "	" " "	"	"	"	"	" "	"	"	"	"	"	"
Dixcove	" " "	" " "	"	"	"	"	" "	"	"	"	"	"	"
Duivendrecht	Van Ommeren	New Waterway Shipbuilding Co.	402·5	55	32·7	6,222	One 8-cyl., 4-cycle, S.A., Harland-B. and W.	740 mm.	1,500 mm.	90	3,350	2,500	Steam and electric
*El Aleto	Lobitos Oilfields, Ltd.	Sir W. G. Armstrong, Whitworth and Co., Ltd.	440	57·2	33·9	7,203	Two 6-cyl., 4-cycle, S.A., Kincaid-Harland-B. & W.	630 mm.	1,300 mm.	115	4,920	4,000	Electric and steam
Itapé	Navegacao Costeria	William Beardmore and Co., Ltd.	370	52	26·75	5,000	Two 4-cyl., 4-cycle, S.A., Supercharged Beardmore-Tosi	26 in.	43½ in.	137	4,780 supercharged	3,625	Steam auxiliaries
Kheti	James Moss and Co., Ltd.	Harland and Wolff, Ltd.	345	47	30·25	2,650	One 8-cyl., 4-cycle, S.A., Harland-B. and W.	630 mm.	1,300 mm.	100	3,310	2,500	4, 65 kW 1, 20 kW
King Edgar	The King Line, Ltd.	Harland and Wolff, Ltd.	400	54·5	34·8	5,130	One 6-cyl., 4-cycle, S.A., Harland-B. and W.	740 mm.	1,500 mm.	90	2,500	1,900	3, 65 kW and steam
King Edwin	" " " "	" " " "	"	"	"	"	" "	"	"	"	"	"	"
Pacific Reliance	Norfolk and North American Steamship Co., Ltd.	Blythswood Shipbuilding Co., Ltd.	435	60	42	6,725	Two 8-cyl., 4-cycle, S.A., Kincaid-Harland-B. & W.	630 mm.	1,300 mm.	115	4,920	4,000	3, 165 kW
Pacific Enterprise	" " "	" " "	"	"	"	"	" "	"	"	"	"	"	"
Pacheco	MacAndrews and Co., Ltd.	Harland and Wolff, Ltd.	270	39	17·5	1,346	Two 6-cyl., 4-cycle, S.A., Harland-B. and W.	630 mm.	1,300 mm.	115	2,495	1,550	Electric
Palacio	" " " "	" " " "	"	"	"	"	" "	"	"	"	"	"	"
Pelayo	" " " "	" " " "	"	"	"	"	" "	"	"	"	"	"	"
Port Fremantle	Commonwealth and Dominion Line, Ltd.	Workman, Clark and Co., Ltd.	475	63	43·3	8,243	Two 4-cyl., 2-cycle, opposed-piston Doxford	580 mm.	1160 × 2 mm.	95	7,300	6,400	4, 250 kW 1, 12 kW
Port Gisborne	" " "	Swan, Hunter and Wigham Richardson, Ltd.	475	63	43·3	8,243	" "	"	"	"	"	"	"
Port Huon	" " "	" " "	475	63	43·3	8,243	Two 6-cyl., 2-cycle, S.A., Wallsend-Sulzer	680 mm.	1,200 mm.	100	7,800	6,000	3, 250 kW 1, 12 kW
Silverbelle	The Silver Line, Ltd.	J. L. Thomson and Sons, Ltd.	425	58·25	28·6	5,320	One 4-cyl., 2-cycle, Opposed-piston Doxford	680 mm.	1300 × 2 mm.	90	5,300	5,000	4, 100 kW
Silverhazel	" " " "	" " "	"	"	"	"	" "	"	"	"	"	"	"
Silvergauva	" " " "	Sir James Laing and Son, Ltd.	"	"	"	"	" "	"	"	"	"	"	"
Silvermaple	" " " "	" " "	"	"	"	"	" "	"	"	"	"	"	"

* Oil tanker.

trials were concluded by Richardsons, Westgarth and Co., Ltd., West Hartlepool, on the single-cylinder airless injection two-cycle double-acting oil engine, which was illustrated in last year's Annual Article. The trials were, we understand, completely satisfactory, and they were supported by the results obtained from an independent test. The engine design has now been prepared for production, and the first unit to be built will have four cylinders with a designed output of 3000 B.H.P., at 90 r.p.m. As built this engine will conform closely to the experimental unit as regards detail, and the symmetrical and generally simple character of the design should lend itself to manufacture at a reasonable cost.

Vickers Ltd., at Barrow-in-Furness, made progress with the construction of two four-cylinder engines of the Vickers M.A.N. double-acting two-cycle type, which will have an output of round 1000 B.H.P. per cylinder, and are to be installed in an Admiralty Submarine Depôt Ship.

Single-acting Four-cycle Engines.

By far the largest number of four-cycle single-acting marine oil engines built during the past year were those of the Burmeister and Wain type, which were constructed by Harland and Wolff, Ltd., and that firm's licencees. At Belfast and Glasgow five sets of machinery were constructed for vessels of the King Line, Ltd., MacAndrews and Co., Ltd., Elder, Dempster and Co., Ltd., and the Anglo-Saxon Petroleum Co., Ltd., the completed vessels only being enumerated in Table II. At Glasgow the work in hand included several sets of engines for British and foreign owners, and machinery for a train ferry ordered by the Entre Rios Railways, which will be a sister vessel to the Dolores de Urquiza, and like that ship will be built by A. and J. Inglis, of Glasgow.

An extensive programme of engine construction was carried out by John G. Kincaid and Co., Ltd., at Greenock, where fourteen sets of Kincaid-Harland-B & W type engines were completed during the year, aggregating over 40,000 indicated horse-power.

W. H. Allen, Sons and Co., Ltd., of Bedford, supplied a very large number of auxiliary generator units, and during the year an opportunity was taken to remodel their standard designs and embody several improvements. Messrs. Allen also supplied two six-cylinder trunk type Allen-B & W type motors for battleship service, which were designed for an output of 450 B.H.P. at 350 r.p.m.

Reference has already been made to the double-acting motors of the Werkspoor type, which were

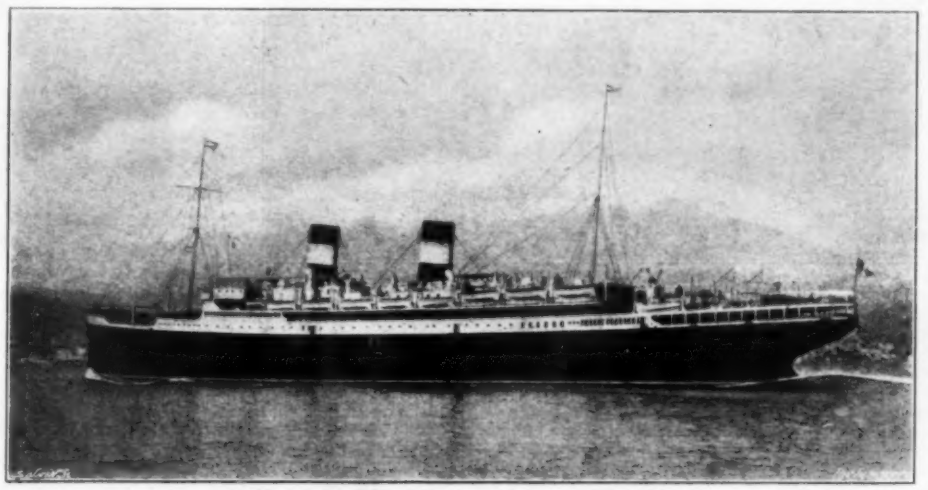


FIG. 1—THE WORLD'S LARGEST MOTOR LINER AUGUSTUS

built by the North-Eastern Marine Engineering Company, Ltd., and Hawthorn, Leslie and Co. These firms also built during the period under review some four-cycle single-acting engines of the Werkspoor type.

A four-cycle engine of a special type is that manufactured by William Beardmore and Co., Ltd., at Dalmuir, in conjunction with Messrs. Tosi, of Legnanó, Italy. During the year three twin-screw sets of

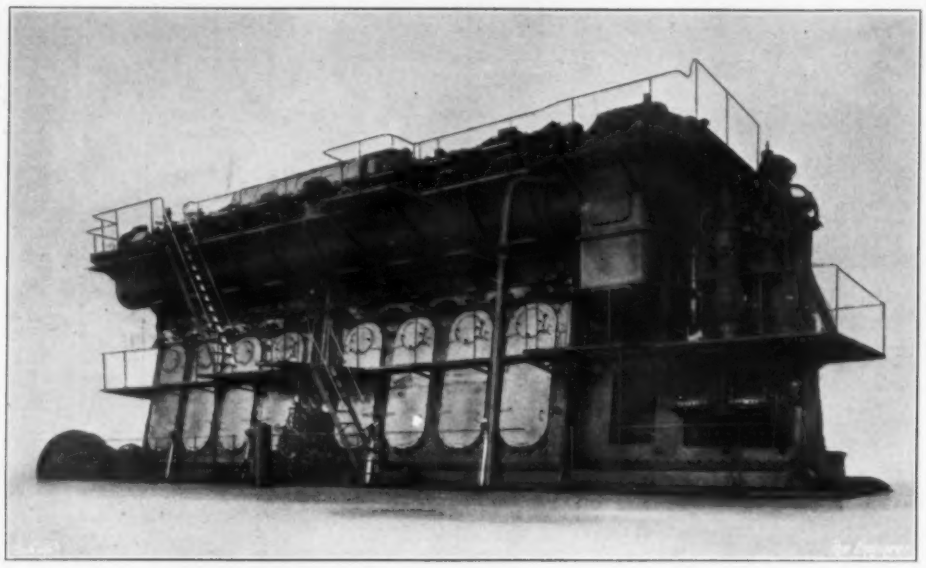


FIG. 2—3500 B.H.P. WORKMAN-SULZER OIL ENGINE

machinery of the Beardmore-Tosi type were built at Dalmuir for Brazilian motor vessels. A full description of the first of these ships, the Itapé, will be found in THE ENGINEER of November 11th. The two sister vessels, the Itaquicé and Itanagé, are now being fitted out. The propelling machinery is of interest, as furnishing a good example of British supercharging practice. With a supercharging air pressure equal to 24in. to 25in. water column, it was found possible to increase the output of both engines from the designed 3300 S.H.P. to 4000 S.H.P., while retaining a clear exhaust and normal cylinder temperatures.

Single-acting Two-cycle Engines.

After close upon three years of regular service in the Pacific Ocean with only three or four days at either terminal port and only one period of lay-up for Lloyd's Survey, the quadruple-screw liner Aorangi, built by the Fairfield Shipbuilding and Engineering Company, Ltd., continues to give, we are advised, unbroken and excellent service. Three other vessels were launched during last year and fitted with Fairfield-Sulzer engines. They were the Cheshire, a repeat order from the Bibby Steamship Company, Ltd.; the Dunster Grange, a repeat order from the Houlder Line, Ltd.; and the Taranaki, a new boat for the Shaw Savill and Albion Company, Ltd. A sister boat for the last-named owners was the Zealandic, launched towards the close of the year by Swan, Hunter and Wigham Richardson, Ltd., and engined by the Wallsend Slipway Company, Ltd., with engines of the Wallsend-Sulzer type, of which several were built during the year. Other Sulzer type engines were constructed by Sir W. G. Armstrong, Whitworth and Co., Ltd., and were installed in vessels built for Norwegian owners. Two motor ships, the Belmoira and Belpamela, built to the order of Captain Smith, and the Rederi Belmoira, will, go on trial early in January. On the Clyde, Denny's have in hand two 800 B.H.P. Denny-Sulzer engines for the vessel Malia, which was originally fitted with Fullagar engines.

We illustrate in Fig. 2 the first Sulzer type engine to be built by Workman, Clark and Co., Ltd., at Belfast. It has a designed output of 3500 B.H.P., and is an eight-cylinder engine with a cylinder bore of 680 mm. and a stroke of 1200 mm., with a working speed of 90 r.p.m. The controls are arranged at the centre of the engine.

Among the Sulzer engines supplied by that firm's Winterthur works, we may mention the four sets of eight-cylinder single-acting motors, with a bore of 680 mm. and a stroke of 1200 mm. for the two Grace liners which are nearing completion at the Furness Shipbuilding Company's yard, Haverton Hill-on-Tees. Each twin screw installation is designed to give an output of 8000 S.H.P. The auxiliary units are also of the Sulzer type, and drive from 270-kW dynamos on each ship. A six-cylinder engine of the same cylinder dimensions with a designed output of 2700 S.H.P. at 100 r.p.m., was fitted in the British Tanker Company's oil-carrying vessel, British Loyalty, built by Palmer's Shipbuilding and Iron Company, Ltd. Messrs. Sulzer also supplied twin-screw machinery of 800 B.H.P. for the private yacht of Mr. A. K. Macomber, which was built by Camper, Nicholson and Co., Ltd.

Combined Oil and Steam Engines.

The continued success of the Holt liner Dolius, the first ship to be fitted with Scott-Still oil engines, which has now completed, in a little over three and a-half years of service, over 200,000 miles, has focussed attention on the new Holt vessel Eurybates, which was launched during the year and is due for trials in February. Twin-screw engines will be installed, each of which is designed for a total output of 3000 S.H.P. at a speed of 105 r.p.m. Each engine, as will be seen from engraving Fig. 3, has seven cylinders, five 27in. in diameter for internal combustion cylinders and two with a diameter of 24in. for steam. All have a common stroke of 47in. The exhaust gases from the combustion cylinders are first passed through a boiler designed to work at 180 lb. per square inch, the steam from which is augmented by the evaporation which takes place in the cylinder jackets. After being used in the steam cylinders, the low-pressure steam is passed to an exhaust steam turbine, which drives the scavenging blower. The engines can be started on steam, and when so run will, in case of emergency, propel the vessel at a reduced speed. Four 100-kW generator sets will supply current for power and lighting. One is of the Scott-Still type and the three others are to be supplied by Mirrlees, Bickerton and Day, Ltd., of Stockport. During the recent trial of the port engine, which is shown in Fig. 3, a fuel consumption of close upon 0·39 lb. per B.H.P. hour was obtained with only part of the heat recovery apparatus in use, so that a still lower consumption in actual service may confidently be expected.

An engine of the same type, but of smaller power, is one built by Plenty and Son, Ltd., of Newbury, for installation in a motor drifter built by Cochrane and Sons, of Selby. A view of it is reproduced in Fig. 4. It is a three-cylinder unit, with a bore of 280 mm. and a stroke of 350 mm., designed to give a normal output of 210 B.H.P., when running at 300 r.p.m. It works in conjunction with a special type of Cochrane boiler, which is furnished with three banks of tubes, one coal fired and the other two for waste heat recovery.

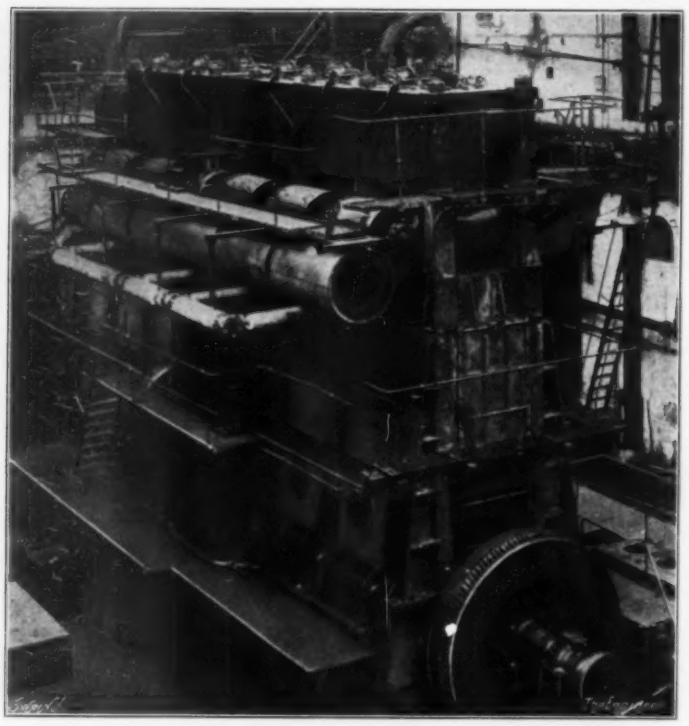


FIG. 3—3000 B.H.P. SCOTT-STILL ENGINE

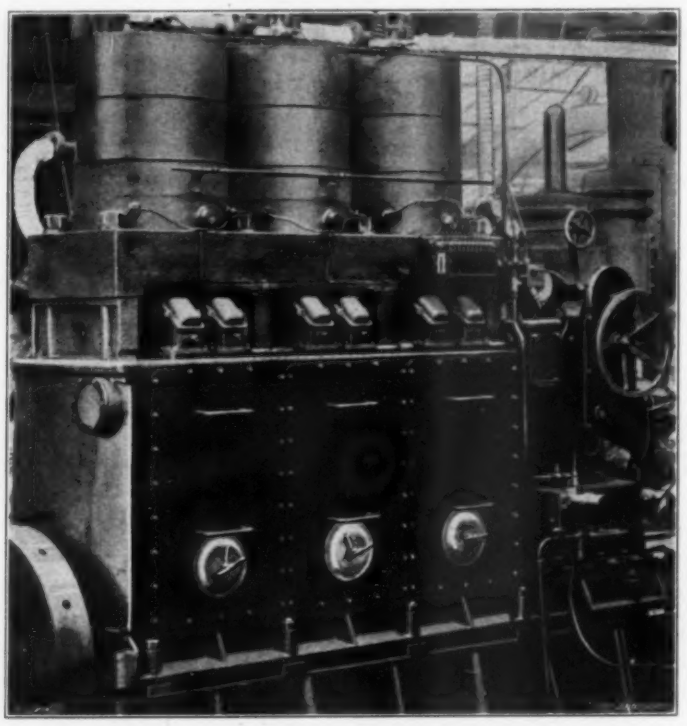


FIG. 4—210 B.H.P. PLENTY-STILL ENGINE

The maximum steam pressure is 150 lb. per square inch, and a suitable air pump and condenser gives a vacuum of 22in. on the steam side. The fuel is injected on the airless system by a fuel pump making 900 strokes per minute. The vessel is expected to run her trials early this month.

Electrically-propelled Motor Vessels.

Interest in the electrically propelled motor ship was aroused towards the end of the year by the trials of the re-engined fruit-carrying ship La Playa, which, it will be recalled, was built by Cammell Laird and Co., Ltd., in 1923. The original Cammell-Laird-Fullagar engines were taken out and were

replaced by three 1000 B.H.P. Fiat four-cylinder, two-cycle, single-acting engines with an equal bore and stroke of 500 mm. The generators and motors, which were supplied by the British Thomson-Houston Company, Ltd., of Rugby, were retained. In the trials of the vessel, which took place in the Adriatic Sea, an average speed of 14·36 knots was attained, or an increase of about 1 knot on the performance of the ship with her old engines. Early in 1927 an order was placed with Scott's Shipbuilding and Engineering Company, Ltd., Greenock, for a 470ft., 12,500-ton motor tanker, which will be electrically propelled. Work on the hull is in progress, and the engines are under construction at the Carels factory of the S.E.M. Company in Belgium, and will be of the Carels-Ingersoll-Rand type, working on the single-acting airless injection principle. Each engine, of which there will be four, will have an output of 750 B.H.P. at 225 r.p.m. and will be direct coupled to a B.T.H. 250-volt direct-current generator. The single-screw propelling motor is to be of the double armature type with a designed output of 2800 S.H.P. at 95 r.p.m.

An engine which should be especially suitable for electric propulsion schemes or for geared transmission is the new quick-running airless injection oil engine which was completed by William Beardmore and Co., Ltd., at Parkhead, during the year. It is shown in Fig. 5, and as built serves to drive a dynamo for train propulsion. Its designed output is 1500 B.H.P. at 900 r.p.m. For marine installations, in which considerable power is required with small weight, this new engine certainly has its own claims.

The Opposed-piston Engine.

An outstanding feature of the year's work was the increase in the number of opposed-piston engines of the Doxford type which were built. That type of engine has met with considerable success both in Great Britain and America, and there is no doubt that one of the most interesting motor vessels of the year was the quadruple-screw liner Bermuda, which was fully described in the issue of THE ENGINEER for Dec. 23rd and 30th, and is illustrated in one of to-day's Supplements. A special feature of the engines fitted into the Bermuda is the adoption of different strokes for the upper and lower pistons, which are so designed to give a well-balanced engine. At the Doxford works in Sunderland no less than fifteen sets of opposed-piston machinery were constructed, while several additional engines are being built under licence by other firms. Another ship illustrated in to-day's Supplement, the Port Gisborne, of the Commonwealth Dominion Line, is also equipped with Doxford opposed-piston machinery. A sister vessel, the Port Fremantle, has similar engines.

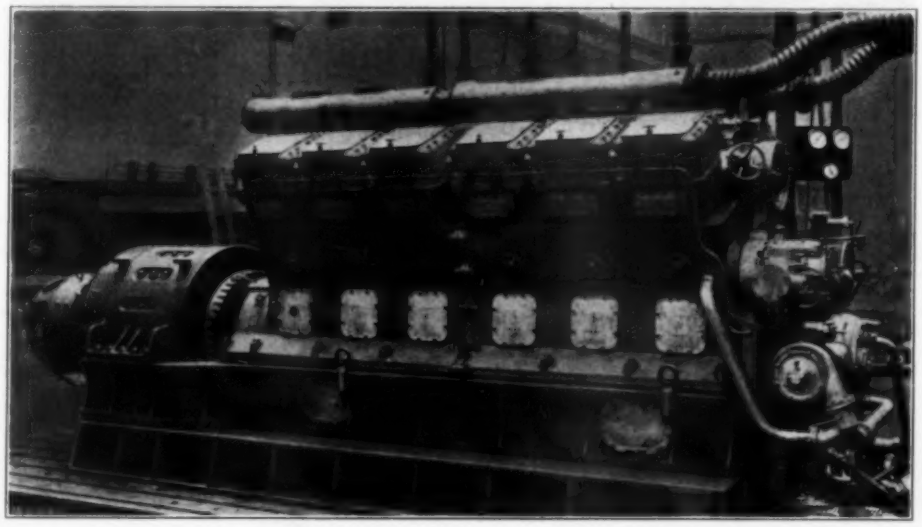


FIG. 5—1500 B.H.P. 900 R.P.M. BEARDMORE OIL ENGINE

Airless Fuel Injection.

There has been a trend in the direction of a further use of airless fuel injection, which is successfully employed in the Doxford engine, the Still, and the Richardsons-Westgarth engines previously referred to. Although the airless injection system has not yet by any means been widely taken up by engine builders who have so far worked with the air injection system, it is of interest to know that the machinery of a motor ship belonging to the Pacific Steam Navigation Company, Ltd., and propelled by standard Harland-B & W type motors, was some time ago converted to work on the airless injection principle and has now successfully completed over 40,000 miles. Although airless injection is widely used in land practice and was fitted to five-cylinder auxiliary engines supplied for marine work by Ruston and Hornsby, Ltd., there are still many who hold that with fuel oils of widely varying physical characteristics a greater degree of flexibility is given by the air injection method. The reliability of modern air compressing plant has also something to do with the retaining of the air injection system, although, if the injection air compressor could be dispensed with a saving in power of from 5 to 7 per cent. might be obtained.

Smaller Marine Motors.

An interesting vessel which is oil engine driven and was commissioned during the year was the motor car ferry boat Fishbourne, described and illustrated in THE ENGINEER of July 22nd. It is a 130ft. boat, specially designed for the ferry service between the mainland and the Isle of Wight, and is propelled by two 120 B.H.P., 340 r.p.m. oil engines of the Gardner type. L. Gardner and Sons, of Patricroft, also supplied twin-screw installations of heavy oil engines for the vessels La Falaise and Iquazu, which were built by A. and J. Inglis, of Pointhouse, Glasgow. Two oil-engined tugs for harbour service in New Zealand were completed by Vickers (Ireland), Ltd., the 600 B.H.P. twin-screw oil engines being supplied by Petters (Ipswich), Ltd. James Pollock and Sons, of London and Faversham, also built several small vessels for river and sea-going service which were equipped with Bolinder oil engines.

Space precludes us from dealing fully with the products of the various firms which manufacture small marine motors. There was a good display of such engines at the recent Shipping, Engineering and Machinery Exhibition held at Olympia, and many representative types were described in our special exhibition articles.

An event of interest in connection with the use of heavy oil in small marine engines was a lecture recently given by Dr. Rasbach, of Robert Bosch and Co., of Stuttgart, under the auspices of A. and J. Stevens, Ltd., of London. The lecturer dealt with the new Acro-motor described in THE ENGINEER of June 10th, 1927, and exhibited a special type of fuel pump and atomiser made as standard units by the Bosch Company. The use of heavy fuel oil in small marine motors opens a wide field of development, and there is no doubt that in the near future progress in this direction will certainly be made.

Continental and American Progress.

The most noteworthy development on the Continent during last year took place in Italy. Twice in that period a liner built in an Italian yard outclassed any other motor vessel in size and engine power. The first ship to take its place as the largest motor vessel in the world was the twin-screw 24,000-ton Cosulich liner Saturnia, which was built at the Monfalcone Yard of the Cantiere Stabilimento Triestino and engined by the Stabilimento Tecnico Triestino, of Trieste. The engines, built under licence from Burmeister and Wain, Ltd., are two eight-cylinder motors of the double-acting four-cycle type, each designed for a normal output of 9000 S.H.P. at 125 r.p.m. and 10,000 S.H.P. when supercharged. The cylinder diameter is 840 mm. with a stroke of 1500 mm. Additional interest was taken in the performance of this ship because her design and construction was superintended by Mr. James Dewar and Mr. A. T. Wall. An illustrated description of the Saturnia will be found in THE ENGINEER of October 7th. Her sister ship, the Vulcania, will be completed in February, and after making a voyage to New York it is likely that she will make a return voyage to an English port.

The second vessel to attain the distinction of being the largest motor vessel afloat was the Augustus, a broadside view of which is reproduced in Fig. 1. She was built for the South American service of the Navegazione Generale Italiana, and has a gross tonnage of 32,650. Her 710ft. hull was constructed and she was fitted out at the Genoa-Sestri Yard of the Ansaldo Company. Her propelling machinery comprises a quadruple-screw arrangement of M.A.N. type, double-acting, two-cycle motors, which were built by the M.A.N. Company conjointly with its Italian licencee the Cantiera Officine Savoia. Each of the four engines has six cylinders with a bore of 700 mm. and a stroke of 1200 mm. and is designed to develop 6250 to 7000 S.H.P. at 120 to 125 r.p.m. The maximum total shaft horse-power is 28,000. The Augustus made successful voyages before the end of the year, and she will certainly be the largest motor vessel in the world for some time to come. Apart from the two large ships we have referred to, some ten other motor vessels were launched and fitted out in Italian yards. Seven of them were equipped with engines of the Burmeister and Wain type, built at Trieste by the Stabilimento Tecnico Triestino. Other vessels were fitted with engines of the Fiat two-cycle type. At the Fiat works there was completed a single-cylinder experimental unit of the two-cycle double-acting type designed for a total output of 2000 S.H.P. A description of that engine will be found in THE ENGINEER of September 2nd, 1927.

An event of interest in German motor shipbuilding progress was the placing of the order for the Kungsholm, a sister ship to the Swedish-American liner Gripsholm, with the Hamburg firm of Blohm and Voss. The machinery for this vessel will, however, be supplied by Burmeister and Wain. Two 7500 S.H.P. engines are to be installed, giving a total output of 15,000 S.H.P. Over twelve motor vessels were completed in Germany during 1927, most of which were engined with M.A.N. type two-cycle machinery. In some ships, however, Deutsche Werke four-cycle engines were fitted, and that firm completed trials on a 700 B.H.P. single-cylinder experimental engine working on the two-stroke double-acting cycle. Marked progress was made in the development of airless injection engines, and we need only instance the Deutz 1000 B.H.P. motor, described in THE ENGINEER for May 13th and 20th, as an example of that type of prime mover. Messrs. Krupp also built a new model of airless injection engine, and at the A.E.G. Works, Berlin, considerable work was done in developing the Swedish designs of Hesselman, which provides for a special type of airless injection fuel valve and a combustion chamber of a particular shape. A full account of the A.E.G.-Hesselman 1000 B.H.P. two-cycle double-acting experimental unit, and the six-cylinder 6000 S.H.P. engines of this type, which are to be constructed at Berlin for the Hamburg-American Line motor vessels, was given by Dr. F. Sass in a paper read before the Institute of Marine Engineers in November last. Towards the end of the year there was tested at the Augsburg Works of the M.A.N. Company a new design of two-cycle double-acting engine which embodies several important improvements. It is a five-cylinder unit with a designed output of 4200 B.H.P. at 90 r.p.m. The main modifications have been made in the engine framing, which has been simplified, and in the adoption of a composite cylinder cover of steel and cast iron. A considerable saving in weight has been effected, and it is proposed to employ airless injection for land engines. Two engines of this type, which are on order for a Berlin power station, will have a designed output of 11,700 B.H.P., which will be developed in ten cylinders. The weight will be about 55 lb. per B.H.P.

There was marked activity in Sweden and Denmark, and the Götaverken, in Gothenburg, completed eight motor ships and built seventeen engines and eleven sets of auxiliary engines. At Copenhagen Burmeister and Wain carried out an extensive programme of engine building and ship construction. Eleven ships were launched and fourteen sets of engines were built. Among the more interesting ships completed during the year we may mention the Arctic motor ship Disco and the Lelandia and Meonia, the twenty-first and twenty-second motor ships built for the service of the East Asiatic Company. These vessels are without funnels and have that distinctive appearance which we associate with motor ships belonging to that line. A somewhat special vessel, engined by Burmeister and Wain, is the rail ferry boat Korsor, a description of which will be found in THE ENGINEER for June 3rd, 1927.

Early in the year the Werkspoor Engine Works, of Amsterdam, commemorated their centenary, and it is of interest to note in passing that the Vulcanus, the first motor vessel constructed, and equipped with a 600 I.H.P. Werkspoor oil engine, is still giving excellent service. Werkspoor constructed five six-cylinder, double-acting, four-cycle engines, with Zulver-Lugt valve gear for the tankers of the Anglo-Saxon Petroleum Company, Ltd., and twin-screw, single-acting machinery for a vessel built in England for the same owners. A two-cycle, double-acting, experimental engine was also completed. At the Fijnoord Yards a fast cargo ship, the Kota Inten, was built for the Dutch Indies service and was equipped with M.A.N. type motors. A similar vessel, the Kota Radja, was built at the Royal Schelde Yard and was equipped with Sulzer machinery. The largest motor vessel built in Holland during 1927 was the Christiaan Huygens, a 570ft. passenger liner for the Netherlands Steamship Company, in which twin-screw, ten-cylinder Sulzer engines having a total designed output of 11,600 S.H.P

were installed. It is of interest to learn that a second ship will be built for the same owners, for which Sulzer Brothers will supply twin-screw, ten-cylinder engines of slightly larger bore and stroke, with a total output of 14,000 S.H.P. Machinery of exactly the same type and power is to be installed in two passenger liners which are to be built for the Rotterdam Lloyd Steamship Company. An item of interest as regards Belgium progress is the arrangement whereby Carels Engine Works at Ghent—now known as the S.E.M. Company—will build, in addition to Ingersoll-Rand engines, double-acting, two-cycle motors of the Worthington type.

A few motor ships were built in France during 1927, two cargo vessels of large power being fitted with St. Nazaire-B & W type motors.

Some important development work was done in Switzerland, where, at the Winterthur Works of Sulzer Bros., a single-cylinder experimental unit, designed to develop 2000 B.H.P. on the two-cycle, double-acting principle, was built and tested. A special system of supercharging which will enable the engine to carry overloads up to 20 per cent. over a short period was investigated. At the neighbouring works of the Swiss Locomotive Company, Ltd., Mr. Büchi continued his experiments with supercharging on a four-cycle engine of 1050 B.H.P., which, when supercharged at about 7 lb. per square inch air pressure by a turbo-blower worked by the exhaust gases, developed close upon 1700 B.H.P. By the end of the year orders were received for several supercharging equipments of this type.

In America interest during the past year was mainly centred in the conversion of steamships into motor vessels under the provisions of the conversion programme of the United States Shipping Board. The first ship so to be re-engined was the Tampa, in which Worthington double-acting, two-cycle machinery was installed. A full account of the Tampa and her engines has already been published in THE ENGINEER, and it only remains to say that during 1927 the Tampa and her sister vessel, the Unicoi, made several long and successful voyages.

Other ships which followed included the tanker E. T. Bedford, which is propelled by Busch-Sulzer engines; the West Honaker, in which McIntosh-Seymour machinery is fitted; and more lately the Seminole, propelled by double-acting Hamilton-M.A.N. motors. During the year the New London Ship and Engine Company completed trials on a double-acting, four-cylinder, two-cycle engine designed to develop 3680 S.H.P. at 115 r.p.m. Another interesting conversion job was the oil tanker Herman Falk, which was equipped with twin-screw Falk engines coupled to a single-screw by gearing and designed for an output of 2600 S.H.P. The transmission gearing is arranged at the forward end of the engine and reduces its speed from 275 to 90 r.p.m, the propeller shaft passing aft between the two main engine bed-plates. By this means a very neat arrangement of plant is obtained with plenty of room for the auxiliary machinery. Some other tanker conversions were the all-electric ships Pointbreeze, Sharon and Bessemer, which, following on successful experience with the electrically propelled vessel Van Dyke, were carried out to the order of the Atlantic Refining Company, of Philadelphia. Each of these vessels was equipped with Ingersoll-Rand-General Electric oil-electric propelling machinery, similar in design to that which will be installed in the tanker for the same owners which is now under construction at Scotts, of Greenock. It is understood that future conversions undertaken by the Shipping Board may include some oil-electric propulsion schemes, and three vessels, the Courageous, Defiance, and Triumph, have been recently set apart for treatment along these lines. Up to date about thirty steamships have been converted to motor vessels. During the year American construction also included a large number of small coastal vessels, tugs, rail and river ferry boats, and dredgers.

Electrical Engineering in 1927.

No. I.

THE period under review may be identified with the beginning of the National Power Scheme, for although the reorganisation of the electricity supply industry has been under consideration for a long time and the Electricity Commission was in active operation in 1920, progress up to the early part of last year was but slow. Since the passing of the Electricity (Supply) Act, 1926, the Electricity Commissioners have been engaged upon the preparation of various schemes, and the first, relating to Central Scotland, was transmitted to the "Board" last May, whilst the second, dealing with South-East England, was issued in October. In view of the wide publicity that has been given to both these schemes, it is scarcely necessary to enter into details concerning them or to discuss the benefits they are expected to bestow upon electricity consumers. Briefly, the objective of all the Government's proposals is to provide a co-ordinated plan for the prospective and future development of generation and main transmission. In the case of the Scottish scheme the standardisation of frequency is involved, and the preliminary stages of this difficult work are said to be well advanced. The cost of the change, in all parts where it is necessary, will be spread over the whole of the undertakings—standard and non-standard alike—and the incidence of the expenditure on the cost per unit sold is not expected to exceed 0·02d. per unit, which will diminish each year as the output increases until the expenditure is amortised.

The Government's proposals to interconnect power stations and to provide a general supply by means of the grid have led many engineers to turn their attention to questions relating to transmission and distribution. To all intents and purposes the problem of generating cheap electricity has been solved, but the task of supplying it to consumers, and especially those in rural parts, still presents difficulties. While in other countries overhead transmission and distribution have proved to be cheap, the rules and regulations and wayleave difficulties in Great Britain are real obstacles to progress, and during the past twelve months much attention was paid to the question of getting existing rules modified and to the possibility of removing the difficulties in the direction of securing wayleaves. With these objects in view an Overhead Lines Association was formed. Other bodies also exist for the purpose of facilitating the erection of overhead lines, and it is rumoured that some, at any rate, of the existing regulations are shortly to be modified. One of the most gratifying events of the year was the general recognition of the fact that if cheap electricity is to be supplied to rural areas the cost of distribution must be reduced to a figure considerably below that which the present rules and regulations entail. When the Government first took the electricity supply industry in hand, the desirability of reducing the cost of coal appeared to be regarded as the only thing that really mattered; but it is now generally admitted that cheap distribution is also highly important.

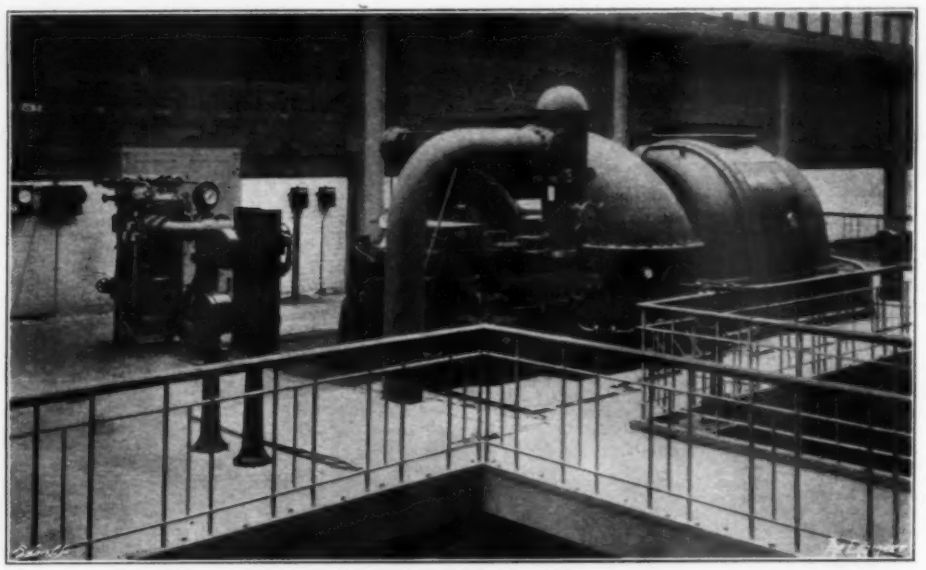


FIG. 1—INTERIOR OF WILLOW HOLME POWER STATION

Power Stations.

Of the various power stations that were put into operation during 1927 one of the most notable was the Stourport station of the Shropshire, Worcestershire and Staffordshire Electric Power Company, officially opened by the Prime Minister on June 2nd. Situated at Stourport, Worcestershire, at the head of the navigation portion of the river Severn, at a distance of 60 miles from Sharpness Docks, the station, of which we give views in a Supplement to-day, presents an exceptionally fine appearance, and the site meets all the requirements of a large generating plant. At present the building contains two 22,500-kVA sets and a house service set, all supplied by the British Thomson-Houston Company. Notwithstanding the proposal to adopt a standard frequency of 50 cycles per second, this new station works at a periodicity of 25 cycles. The Ferrybridge station of the Yorkshire Electric Power Company was recently completed and put to work, and we described it fully in our issues of October 28th, November 4th and 11th. The turbine house of the first portion of the station is equipped with two 23,750-kVA Brown-Boveri sets, which are illustrated in our Supplement. The machines run at a speed of 3000 revolutions per minute, and they are among the largest in existence designed for that speed. The steam pressure is 315 lb. per square inch and the total temperature 700 deg. Fah. The initial equipment of the boiler-house comprises eight Stirling boilers, each designed to evaporate 75,000 lb. of water per hour. Early in the year the official opening took place of a new electric generating station in the Borough of Poplar, where, in consequence of the development campaign initiated by the Borough Electrical Engineer, Mr. J. H. Bowden, the demand for electricity is rapidly increasing. The station contains at present a new G.E.C. 12,500-kVA generating set, which is illustrated in our Supplement. A feature of the station is that the boilers are fired with pulverised coal, the pulverising plant having been supplied by International Combustion, Ltd., and the East Ferry-road Engineering Company.

A new station, known as the Willow Holme station, was opened at Carlisle, where electricity was first made available for public use on May 11th, 1899. The turbine house—see Fig. 1—is designed to accommodate two 6000-kilowatt, one 3000-kilowatt, and one 2000-kilowatt turbo-generator sets. At the outset the station was only equipped with the 6000-kilowatt set, which was supplied by the British Thomson-Houston Company. The 3000 and 2000-kilowatt machines are being transferred from the old James-street station, whilst the additional 6000-kilowatt set will be installed as soon as the load warrants it. The steam conditions of this new station are not by any means exceptional, the object aimed at being to obtain the highest thermal efficiency compatible with reasonable capital and maintenance costs. Steam is admitted to the turbines at a pressure of 250 lb. per square inch and at a total temperature of 650 deg. Fah., and it exhausts into a vacuum of 29·1in.

A new station was constructed at Guildford by C. A. Parsons and Company, Ltd. The first sod was cut on January 1st, and the station was supplying power on November 23rd. The present capacity of the plant is 6000 kilowatts.

In our issue of June 3rd we described various extensions that have been made from time to time at the Deptford station, which now has a capacity of over 100,000 kilowatts. An entirely new 50-cycle station is being erected, which will be connected to the old station through a frequency changer. The steam pressure of the modern plant in the existing station is 325 lb. per square inch, and the total temperature 725 deg. Fah. In an extension to the boiler-house, six additional boilers are being installed, each having a normal capacity of 64,000 lb., and an overload capacity of 80,000 lb. per hour. As it stands to-day, the Deptford electric generating station, in which so much pioneer work was undertaken, bears little resemblance to the station which Dr. Ferranti designed in 1887. Extensions were made to the Treforest station of the South Wales Electrical Distribution Company, which will ultimately contain six sets with capacities ranging from 16,000 to 20,000 kilowatts. In an addition to the original building a 16,000-kilowatt—see Fig. 2—and two 1000-kilowatt house sets were installed, together with the necessary boiler plant. The steam pressure is 350 lb. per square inch, and the total temperature 750 deg. Fah. Eventually the new plant will take over the work of the old plant which is gradually being put out of service. Extensions were also made to the Central power house of the city of Stoke-on-Trent. The turbine-room and boiler-house were enlarged and a new 10,000-kilowatt turbo-generator, made by the Metropolitan-Vickers Electrical Company, was installed, together with two Babcock boilers, designed for a normal output of 60,000 lb. of steam per hour at a pressure of 260 lb. per square inch and a total temperature of 660 deg. Fah. The largest Ljungstrom turbine built by the Brush Electrical Engineering Company was installed in the St. Pancras Borough Council's King's-road generating station. The machine is designed for a normal load of 10,000 kilowatts, and its overload capacity is 25 per cent. The stop valve pressure of the turbine is 200 lb. per square inch, and the steam is superheated to 688 deg. Fah. There are, of course, two alternators, which are ventilated on the closed circuit system.

The fact that Great Britain is not blessed with

abundant water power resources has not had the effect of causing British manufacturers to neglect the construction of hydro-electric plant. On the contrary, a fair amount of this plant is now built in this country for use abroad and for operation in hydro-stations in Scotland and Wales. One of the most interesting of the Scottish schemes is that of the Clyde Valley Electrical Power Company, described in our issues of September 30th, October 7th and 14th of last year. The two stations, Stonebyres and Bonnington, illustrated in our Supplement, were

FIG. 2—INTERIOR OF TREFOREST POWER STATION

completely equipped with plant by the English Electric Company, which now has other interesting work of this nature in hand. The capacity of the plant at the former station is 5680 kilowatts, whilst that at the latter is 9840 kilowatts. A firm that seems to be doing fairly well in the way of securing orders for water-wheel alternators is the Metropolitan-Vickers Electrical Company, which has recently completed three 13,330 kVA alternators for the Maipo River power station of the Compania Hidro-Electrica Volcan of Chile. Two 20,000 kVA water-wheel alternators and others for New Zealand and India are also under construction in the company's works.

A contract amounting to no less than £1,458,000 was awarded early in the year to International Combustion, Ltd., by the City of Birmingham Electricity Department for the whole of the work involved in the construction of the first section of the new Hams Hall superpower station, which is one of the new stations to be built under the Government's electricity scheme. The boilers, which are to work at a pressure of 375 lb. per square inch, are to be fitted with pulverised coal firing equipment manufactured by International Combustion, Ltd. Each of the main turbo-generators will have a capacity of 30,000 kW, whilst the house generators will have an output of 1500 kW. The whole of the specifications for the scheme were prepared by Mr. R. A. Chattock, the City Electrical Engineer, who was the first municipal engineer in this country to adopt pulverised fuel on a relatively large scale. Mention has been made of the power station work described in our columns during the year, but it is, of course, to be remembered that some power station engineers refrain from publishing accounts of extensions to their stations, and the foregoing account might be considerably extended. Some idea of what is taking place can be gained from the fact that the aggregate capacity of the generating plant for new stations and extensions of existing stations sanctioned by the Commissioners during the year 1926–27 amounted to 775,604 kW. During the year ending March 31st, 1927, the Commissioners issued nineteen consents in respect of the establishment of new generating stations, representing the initial installation of plant with a total rated capacity of 236,100 kW.

Electrical Plant.

In reviewing progress in electrical engineering during 1926 reference was made to a 33,000-volt, 31,250-kVA turbo-alternator under construction at C. A. Parsons' works. During the period under review the machine has undergone various tests. Conductor bars selected at random were subjected for several months to a reliability pressure test of 75 per cent. above the working pressure, and they stood up to this test without signs of deterioration, whilst on the short-time pressure test the centre conductor of each bar was raised to a pressure of 100,000 volts. A 6000-kW turbine under construction in the Heaton Works is designed for a pressure of 550 lb. per square inch and a total temperature of 750 deg. Fah. It is a pure reaction machine with a high-pressure unit running at 6000 revolutions per minute and a low-pressure portion designed for a speed of 3600 revolutions per minute. The two units, arranged side by side, are coupled through speed reduction gearing to three continuous-current dynamos in tandem. Each of these generators is capable of developing 2000 kW at a pressure of 250 volts when running at a speed of 350 revolutions per minute; the total current output being 24,000 ampères. What is believed to be the largest continuous-current dynamo built in this country for a speed of 500 revolutions is also going through the Heaton Works. Its output is 3000 kW at460 volts and the current is therefore 6500 ampères. Turbine designs have been prepared by C. A. Parsons and Co., Ltd., for pressures up to 1200 lb. per square inch. Large turbo-generator sets designed for a speed of 3000 revolutions per minute are being built by all the leading firms. The 30,770–38,000-kVA Metropolitan-Vickers machine mentioned in our review of electrical engineering in 1926 has successfully passed its tests, during which it carried a continuous load of 40,000 kVA. Other large 3000 revolution per minute machines are now under construction at the Trafford Park Works, and in other works, but we cannot refer to all these sets individually. Orders for generating plant received during the year by the Metropolitan-Vickers Electrical Company amounted in all to about 450,000 kVA. In anticipation of a demand for exceptionally large generating units, the British Thomson-Houston Company has made preparations for the manufacture of sets up to 100,000 kW. Further experimental work was carried out by this company on binary cycles and on the question of reheating between turbine stages. During the year the company developed a new range of small geared auxiliary turbines, consisting of a single-stage Curtis compounded velocity wheel overhung on the high-speed pinion shaft. The machines are for driving centrifugal circulating water pumps and alternators, &c. Following the experimental work which the English Electric Company has been carrying out for the last three or four years on the use of exceptionally high steam pressures, an order was received for a superposed high-pressure plant for the Valley-road power station of the Bradford Corporation. The plant comprises a boiler for generating steam at a pressure of 1100 lb. per square inch and a high-pressure turbine which will exhaust into the existing 200 lb. steam main. For extensions at the Barking station, Yarrow and Company, Ltd., are supplying three boilers, designed for a pressure of 400 lbs. per square inch. One of these boilers will evaporate 102,000 lb. of water per hour, whilst the other two will each evaporate 60,000 lb.

Difficulties in the direction of building single-armature, 1500-volt rotary converters are said to have been completely overcome. Eight machines of this kind are at present under construction in the English Electric Company's works, whilst twenty-four single-armature rotaries, designed for this voltage, are in operation on the Midi Railway in France. The experience of the English Electric Company is said to have shown that rotaries built for this pressure are just as reliable as two 750-volt machines connected in series. The diameter of the commutator of these high-voltage machines is equal to that of the armature, and special precautions are taken to extinguish arcs set up by heavy overloads and short-circuits. Flash barriers are fitted between the different sets of brushes and a current of air is caused to flow across the commutator, which does not suffer any material damage when overloads and heavy short-circuits occur. While it is now generally agreed that conversion adds appreciably to the cost of electricity, many rotary converters are still made for traction purposes. The Metropolitan-Vickers Electrical Company has sent us particulars of many rotary converter and motor converter contracts. Similar information has also been provided by the British Thomson-Houston Company.

Some important advances in transformer design were made by Ferranti, Ltd., of Hollinwood. The system of varying the voltage of transformers by changing tappings whilst the windings are carrying load is not, of course, new, but we believe that we are correct in saying that prior to the introduction of the Ferranti tap-changing equipment this class of gear was not made in England. A patented tapping switch mounted in the main transformer operates directly on the transformer

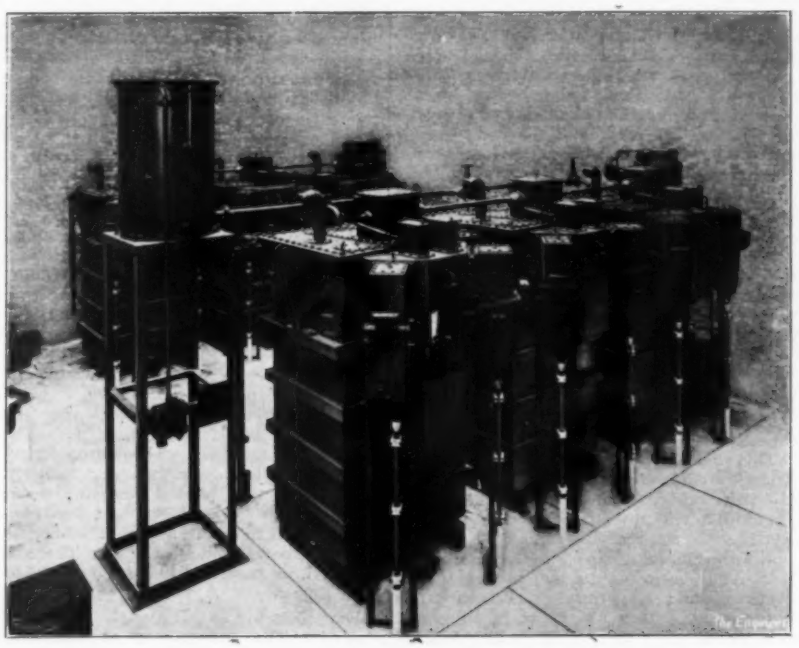


FIG. 3—FERRANTI TRANSFORMERS WITH TAPPING CHANGING GEAR

windings. The system was fully described in our issue of August 26th. Briefly, parallel windings are provided on one side of the transformer—generally the high-pressure side—and normally each of these windings carries half the line current. When it is desired to change the voltage the circuit through one of the windings is opened by means of a quick break oil switch—known as the series switch—and the tappings on this winding are charged. During the short time taken for this operation the winding left in the main circuit carries the total current. The

series switch then re-closes, and afterwards the same operation is carried out on the other winding, which is afterwards connected in parallel with the first mentioned winding as before. Thus the voltage is changed by the operation of the series and tapping switches in the proper sequence without the load being interrupted. While the principle has long been known, the mechanism associated with this new Ferranti gear is distinctly ingenious. A bank of transformers fitted with this new regulating gear and supplied to the London Power Company is shown in Fig. 3.

To meet the requirements of the National Electricity scheme the English Electric Company has been giving attention to the protection of very large transformers capable of dealing with as much as 100,000 kVA at a pressure of 132,000 volts. Induction regulators have long been among the English Electric Company's products, and, in view of the proposal to interconnect power stations, regulators of this type have been developed for interconnectors of 12,000 kVA and over. Fully automatic self-contained outdoor induction regulators rated at 3 kVA and upwards are also being manufactured for the control of lighting feeders.

Electro-Farming.

Over one hundred farms, including that of the Prince of Wales, were connected to transmission lines, while many farmers, previously using electricity, increased the number of applications. Over one hundred and seventy-four manufacturers, Mr. Borlase Matthews informs us, now produce electrical apparatus for use on the farm, although it can hardly be said that the ideal British agricultural motor has yet made its appearance. The National Farmers' Union recently stated, in reply to the memorandum issued by the Electricity Commissioners on Electricity Supply in Rural Areas, that the attitude of farmers in regard to wayleaves would be vastly different if they knew that the agricultural areas would stand to gain if wayleaves were facilitated. What they seem to fear is that wayleaves are required solely for the purpose of cheapening the linking up of urban communities. The electricity supply undertakings that have done the most important rural electrification work are the Fife Electric Power Board, the Ayrshire Electricity Board, the South Wales Electrical Power Distribution Company, the Mid-Cheshire Electric Supply Company, and the electricity departments of the City of Chester and the Borough of Aylesbury. The matter of rural electrification is claiming the attention of the Government. Colonel Wilfred Ashley recently stated that the Ministry of Transport had commenced a study of the problem of supplying electricity to rural areas, and the best method of applying the Electricity Act of 1926 with Government assistance to agriculture, so that the farmers might have a supply of electricity for power and lighting purposes. The Conservative Agricultural Committee appointed during the year a deputation to visit Sweden, and in its report it recommended that a rural Electrification Parliamentary Committee be established, and that the Government should be requested to set aside funds for the electrification of rural areas by approved associations on easy terms.

Among the matters that received special attention during the year were electric transport on the farm, electric ploughing, the electric treatment of bees, the application of ultra-violet ray to farm live stock, and the revival of the use of earth current apparatus in market gardens and on farms. Recently the first British-made electric plough was dispatched to Africa. In Mr. Borlase Matthew's opinion the future of electro-farming is very promising, and the time is not far distant when British farms will be in an even happier position than those in California, where it is claimed that of the power used in agriculture 42 per cent. is electrical, whilst over 60 per cent. of the farmhouses have electric light.

Wireless Telegraphy and Telephony.

When the Post Office decided to establish a Transatlantic wireless service, the site selected for the receiving station was at Wroughton, in the South of England. This spot was chosen primarily on account of the existing line connections to London, but experience, both in this country and in America, proved that reception in more northernly latitudes would be more satisfactory, because the received signals are usually stronger and atmospheric disturbances generally less pronounced. After various tests had been made, it was decided to build a permanent Transatlantic telephony receiving station at Cupar in Fifeshire, where the antennæ are 3 miles long and are spaced at a distance of approximately 1·9 miles. The construction of the station was begun on January 14th, and the station was ready for service on April 13th. Experience gained during the summer showed that the new station gave improved results, and that the money spent on its construction was justified. The speech from America is transmitted by high-grade underground land lines to the "American service" control position in London.

The Transatlantic telephony service was opened on January 7th, and from that date to the present time it has proved an efficient long-distance telephone link. The traffic is said to have justified the enterprise. Within the limitations which are common to long-distance communication, the service, which guarantees conversation between the Pacific Coast and London, a distance of one-fourth of the world's girth, is in every way satisfactory. For long-distance wireless communication with ships a new transmitting station at Portishead is now approaching completion. The equipment at the new station, which will replace the Devizes station, will consist of one 25 kilowatt and two 6-kilowatt transmitters, all controlled on the tuning fork principle to ensure a constant frequency. During the year the long-wave Post Office services to ships were supplemented by a short-wave service from the Devizes station. The number of ships carrying short-wave transmitters is steadily increasing, and more and more traffic is passed through the short-wave channel. For the most part, the short-wave service is used by ships in distant parts, such as the Australian waters, Rio de Janeiro, Buenos Aires, and extreme South America and South Africa, which are out of range of the long-wave ship and shore stations. For communication with ships and for giving bearings to ships when called for, a new station, known as the Humber Radio Station, was erected at Mablethorpe, in Lincolnshire. It replaces the ship communication station at West Pier, Grimsby, and the direction-finding station at Flamborough Head. The interrupted continuous-wave system is used, because it is less liable to interfere with other services than the spark system, as employed in the old stations. A radio telephone is also installed in this new station for dealing with telegraphic traffic from trawlers by telephone. If suitably equipped these vessels will be able to communicate with the stations without having to employ a skilled wireless telegraphist.

One of the most important wireless developments was the completion of the last of the short-wave wireless beam stations built by the Marconi Company for the British Government for the purpose of linking this country with its three great Dominions and India. Other noteworthy achievements were the building of beam stations at Dorchester and Somerton, from which the Marconi Company is conducting high-speed telegraph services with North and South America, and the establishment of an experimental short-wave broadcasting station at Chelmsford to determine the possibilities of Imperial and world-wide broadcasting. The transmitting stations for the Canadian and South African beam services are situated near Bodmin in Cornwall, and the receiving stations near Bridgewater in Somerset. The Australian and Indian transmitting stations are near Grimsby and the receiving stations at Skegness in Lincolnshire. All these stations employ the flat grid reflector system, developed by Mr. Franklin, of the Marconi Company. Speeds hitherto unobtainable have been secured. On one occasion a speed of 325 words per minute was recorded at Skegness, but the normal speed of working is 100 words per minute. The wave lengths used for these services are between 16 m. and 34 m., and they are changed according to the daylight and night periods. This practice of varying the wave length is not adopted in the case of the Australian services, but transmissions are made in an easterly or westerly direction, according to the time of day, by using two sets of active aerials back to back, with one reflector system common to both aerials between them. According to the time of day, one or the other of the aerials is energised. A Morse signal sent by an operator at the Central Radio Office in London is instantaneously recorded in Montreal, Cape Town, Bombay or Melbourne, as the case may be. The overseas telegraph offices also automatically control their respective transmitting and receiving stations, so that communication on all the beam services takes place direct from capital to capital. In the Dominions and India the beam stations are owned and operated by the Associated Marconi Companies. An additional beam service between Montreal and Melbourne is now being tested by the Canadian Marconi Company and the Amalgamated Wireless Australasian, Ltd., and when this inter-Dominion link is complete, it will be possible for London to communicate with Melbourne direct or through the additional channel, *viâ* Montreal. The beam services which have been brought into operation between London, New York and South America are operated by the Marconi Company through its own beam stations at Dorchester and Somerton by remote control from the main telegraph office, Radio House, Wilson-street, London, E.C. 2. These stations are designed so that additional services can be added from time to time.

Experiments in Imperial broadcasting were started. The transmitter at the Marconi Company's works, to which the call sign 5 S W was allotted, transmits on a wave length of 24 m. Although some very gratifying results have been attained, considerably more research work will have to be undertaken before it can be definitely decided whether an Empire broadcasting service from this country can be established. On several occasions music and speech transmitted from the Dominions have been received satisfactorily in this country and have been re-broadcast, although it cannot be said that the reception problem has been completely solved. In order more closely to investigate the problem of long-distance broadcast reception, the engineers of the Marconi Company and those of the British Broadcasting Corporation have started a comprehensive series of tests to determine the best possible method of receiving long-distance signals capable of being re-transmitted by the broadcasting stations in this country.

The shielded valve, an invention of Captain Round, was exhibited for the first time at the National Radio Exhibition, held in September. The object of the valve is to obtain a high degree of radio amplification without self-oscillation, which has been the drawback of all systems designed to give large high-frequency magnification. Receivers incorporating these new valves are being put on the market. Loud speakers for wireless reception underwent improvement. Hand in hand with research in this direction investigation was made into the acoustical performance of gramophones. By applying the principle of low-frequency amplification with the aid of valves, as used in wireless reception, it has been possible greatly to improve the qualities of gramophones. Until recently, the recording of gramophone discs has suffered from several disadvantages, owing to the inability of the recording devices properly to reproduce the full scale values of the complete musical register. In conjunction with the gramophone industry, however, the Marconi Company has made a close study of the processes of recording and has developed a method of electrical recording in which broadcasting microphones and valve amplifiers are used for the recording of speech and musical items. The combination of gramophone records made in this way and the improved amplifying and acoustical properties of the latest type of gramophones have advanced reproduction to something approaching perfection.

(To be continued.)

SIXTY YEARS AGO.

IF it is difficult to name any outstanding discovery or undertaking which in the years to come will make 1927 famous in the history of engineering, equally difficult was the task which we set ourselves in our issue of January 3rd, 1868, to review the progress of our profession in the year that had just closed. The year 1867, we wrote, had been a period of almost unexampled depression in the commercial world. No progress worthy of the name had been made in engineering or its kindred arts. We had not a single great discovery to record, not one highly important invention to describe; nor had any great engineering feat been accomplished. We dismissed the suggestion that the dulness of the past year had been caused by feebleness or incapacity or sordidness of spirit on the part of the engineer. We saw in it nothing more than the operation of very powerful causes tending to a certain end. The engineer plied his profession inspired by various motives, but it would be mawkish sentimentality, we said, to deny that the desire for reward had done more than any other stimulus to encourage the development of that complex combination of science and handicraft which was called engineering. As gold could or could not be won, so did the star of practical engineering brighten or pale its fires. In 1867 money was not to be made by anything which the engineer could do. The grand stimulus had been wanting, and, as a consequence, engineers had not been employed and nothing had been done. We looked to the engineer himself to shake off the lethargy hanging over all things scientific and commercial. The profession in the past had not only executed work but had pointed out to capitalists the direction in which work could best be done with the hope of profit. It was unlikely that when capitalists were once more prepared to embark in the ship of speculation the engineer would lack the power or the will to grasp the helm. In some measures engineers were, we said, responsible for the prevailing misfortunes. They had to convince the public that they were swayed more by the desire to make works pay than to make them temples of fame built to themselves with money borrowed at ruinous rates by too confiding shareholders. Once confidence in the abilities of the profession to initiate, design and carry out works to a consummation remunerative to all concerned was re-established, a glorious future, we maintained, would open before us. Meanwhile we had to be content to labour and wait.

THE outstanding danger that such a snowstorm as was experienced during Christmas week brings to railway operation is the failure of signals to remain in the "on" position, coupled with the suspension of block working owing to the weight of the snow on the telegraph wires bringing them down and destroying telegraphic communication between the adjoining signal-boxes. Were the question asked as to what accident was noteworthy in that respect most people would probably name that at Abbott's Ripton on January 21st, 1876, but only twenty-one years ago there was the far more serious disaster at Elliot Junction, on the Dundee and Arbroath Joint Line. There, on December 28th, 1906, twenty-one passengers were killed, as compared with fourteen at Abbott's Ripton. The Elliot Junction case presented many features that were to be regretted—the driver had been treated to drink by some passengers; he was not warned that the signals were not working; no flagmen were out in substitution of the fixed signals. In the Abbott's Ripton case, on the other hand, little blame was attached to any servant, and all the passengers who lost their lives were killed when the Leeds express, which approached almost directly, ran into the wreckage caused by the up Scotsman colliding with the coal train that was being shunted for its passage. Except the Elliot Junction accident no collision has been inquired into since February, 1900, that was caused through snow interfering with signals; in the month just named there were three such collisions on the North-Eastern Railway.

Railway Matters.

IN this column of our issue of June 10th last mention was made of two new railways in the Punjab—the Shahdara–Narowal and the Amritsar–Narowal. The former was opened in December, 1926, and the latter on May 4th last. A further 32 miles of the Amritsar line was opened on December 20th.

THE intended removal of the Belfast steamship services from Fleetwood to Heysham—which should have been effected last November but is postponed until the spring—will set free a considerable area at Fleetwood which will allow for further accommodation for dealing with the fish traffic. Work has now been begun on a scheme towards that end which it is estimated will cost £100,000.

IN this column of our issue of July 16th, 1926, it was stated that owing to coast erosion the Walton-on-the-Naze branch of the London and North-Eastern Railway between that place and Frinton was being imperilled. It is now announced that, under the Railways Act, 1921, the Ministry of Transport has made an Order for the acquisition of land and for the construction of works to allow the line to be diverted.

THE position of divisional engineer, London, Midland and Scottish Railway, at Manchester, vacant by the retirement of Mr. W. H. Coomber, has been filled by the removal thence of Mr. E. H. Townshend, the divisional engineer at Lancaster. The office of divisional engineer at Crewe, which has been open since Mr. Newlands was made the engineer-in-chief a year ago, has been taken by Mr. W. E. Thornhill, the district engineer at Bangor.

So far as we can see, the only names of particular interest to railway men contained in the New Year's Honours are two Indian appointments. Mr. A. A. Biggs, the Agent of the Madras and Southern Mahratta Railway, receives the honour of knighthood and Mr. A. T. Stowell, the Acting Agent of the North-Western Railway, is made a Companion of the Order of the Indian Empire. Mr. Biggs is the President, this year, of the Indian Railway Conference Association.

THE text of the Bills deposited by the four grouped railway companies, by which they seek powers to own, use and work road vehicles, has now been made public. It is of interest to know that, among other things provided for, it is laid down that "a record of such rates and charges shall be open to any person interested," and for "any representative body of traders to apply to the Railway Rates Tribunal to reduce any rates or charges of which complaint is made, and the Tribunal may make such modifications as may seem just." Powers are sought to convey mails.

ON the Northern Counties section of the London, Midland and Scottish Railway—that which used to be the Belfast and Northern Counties Railway—the trains ran into Greenisland Station and there reversed their direction. Such has been the procedure since the railway was opened between Belfast and Carrickfergus and between Greenisland and Ballymena, on April 11th, 1848. Until about the end of last century the station now known as Greenisland was called Carrickfergus Junction. It is now proposed to construct a curve between the line from Belfast—which proceeds from Carrickfergus to Larne—and that from Greenisland to Ballymena and Londonderry, so that the reversal at Greenisland will then be avoided, and notice has been given by the railway company of its intention to seek powers for the purpose in the next session of the Parliament of Northern Ireland.

THE tramway track along College-street, Sydney, is, according to Mr. A. G. Wray, laid on old flat-footed rails as sleepers. The sleepers were placed at 1ft. 8in. centres at rail joints with another sleeper 3ft. 4in. away from the same, and subsequent sleepers at 6ft. 4in. centres. The flanges of the 80 lb. running rails are held by cast steel clips, bolts passing through these and the flange of the sleeper rail, a spring washer being provided between the nut of the bolt and the clip. Running rails are entirely insulated from the sleepers by means of red fibre, varnish impregnated ⅛in. thick, between the rails, and Micarta with cambric base under the clips, with a locally made bituminous material—commonly used for roofing purposes—laid between the running rail and concrete. The rail joints are of the type developed by the Sydney tramway system, consisting of specially designed fish-plates welded to the rails with a base-plate underneath, also welded to the rails, extending over the two joint sleepers, with expansion joints, of the usual mechanical type, at intervals of about 320ft.

THE Cork City Railways were described and illustrated in THE ENGINEER of January 12th, 1912. They consist of a railway connecting the Cork, Bandon and South Coast line with the main system of the Great Southern and Western, two Scherzer rolling-lift bridges across the North and South channels repectively of the river Lee, and a branch from the Victoria quay, which is on the south side of the river, and was thus also joined on to the Great Southern system. The new line was part of the ambitious scheme of the Great Western (of England), the main features of which were the Fishguard and Rosslare steamship route, the direct line to Waterford, and the bridging of the rivers Barrow and Suir. The traffic, owing to the political conditions in Ireland, did not realise its expenses, and some four years or so ago the Great Western volunteered to make a gift of the property to the Great Southern. The latter declined the offer, so it was proposed to seek parliamentary powers to abandon the line, but before any steps therein were taken the Free State Government opened its inquiry as to the future of the Irish railways. The amalgamation Act which resulted, placed the Cork City Railways in the group that became the Great Southern Railways, and automatically the Great Western (of England) was released of all its liabilities therein. The Great Southern now proposes to abandon the railway, but as the closing of the bridges would be a public inconvenience, the company is prepared to leave them if suitable terms can be arranged. The Cork City authorities maintain that if the railways do not pay they are in a similar position to many branch lines, and it was for the poorer lines to be helped by the more fortunate that amalgamation was provided. Further, financially to assist the Cork City Railways would create a bad precedent.

Notes and Memoranda.

IT is proposed to raise a fund of 2,000,000 dollars in Ontario for the purposes of organising industrial research work.

IT is estimated by the Mississippi River Commission that its scheme of flood control will cost 684,000,000 dollars.

PREPARATIONS are being made for the open-cut mining of the coal seams to the west of the Fushun Collieries. The output is to be 350,000 tons a year.

IT is claimed that the recently discovered potash deposits in the Solikamsk district of the Ural Mountains contain over 1500 million tons of potassium oxide. The mineral lies at a depth of about 600ft.

A TABULAR statement published by the *Engineering News-Record* shows that the vessel with the tallest mast plying into New York is the Majestic, 221ft. high; but the majority of ships' masts range about 160ft. high.

AT the end of last year the total installation of water power plants in Canada was 4,883,000 horse-power, and if the present rate of increase continues will easily have passed the 5,000,000 mark by the end of 1928. The capital expenditure on the plant is estimated at 900,000,000 dollars.

APPARATUS has been devised by Monsieur James Basset, of Paris, with which he can attain pressures as high as 150 tons to the square inch. The compressor he employs is of the two-stage type. In the first stage a liquid is compressed to a pressure of 6 tons to the square inch, and this liquid is then used to actuate the piston of the second stage.

ACCORDING to a note, by G. W. Picksen, in the *Journal* of the Engineers' Club of Philadelphia, no recorded observations are available, but, using data obtained by studying the lift of water due to the action of waterspouts at sea, it has been estimated that wind velocities within a hundred feet of the centre of a tornado may be as high as 500 miles per hour.

BRITISH COLUMBIA is the world's fourth largest producer of lead and the world's third largest producer of zinc; Canada's largest producer of zinc, largest producer of copper (two-thirds of the total), largest producer of lead (94 per cent. of the total), first producer of silver, second largest producer of gold, and Canada's second largest producer of all minerals.

A RESEARCH laboratory for welding has been established at Lehigh University. The installation of the necessary apparatus has been made possible by the General Electric Company, the Lincoln Electric Company, and other donors. The apparatus includes a welding motor generator, automatic arc welding equipment, a Thompson electric spot welder, and oxy-acetylene equipment.

DURING the year 1925–6 the helium gas plant at Fort Worth, Texas, produced 9,355,623 cubic feet of helium at an operating cost of 3·41 cents per cubic foot, but in the following year the production declined to 6,330,000 cubic feet and the cost went up to 4·37 cents. Other helium sources are now under study, according to the annual report of the Bureau of Mines, just issued. It is expected that from these sources larger quantities of helium may be produced for the War and Navy Departments, at a very much lower cost per unit.

A GEOLOGICAL investigation bureau has been organised in China for surveying and investigation work in Kwangtung and Kwangsi provinces. It will print maps showing mines and geological conditions in different parts of the two provinces, while its indoor staff will do research work on minerals, rocks, paleontology, &c. The bureau is also organising a library and a museum for which specimens of minerals, rocks, fossils, &c., are being collected. The Kwangtung Government has appropriated £1000 a month for upkeep and provided £2000 for inaugural expenses.

SOME idea of the rate of growth of the road motor services run by the South African Railways can be gathered from the following statistics taken from the *South African Engineer*. At March 31st, 1927, a route mileage of 4282 was being operated. The distribution and increase in the past twelve months are as follows:—Cape, 1494 (+ 1167); Orange Free State, 163 (+ 163); Natal, 460 (+ 460); Transvaal, 2110 (+ 886); and South-West Africa, 55 (unchanged). The aggregate mileage run by the vehicles during the year ended March 31st, 1927, was 1,218,783.

A WARNING as to the maintenance of boiler manhole doors is given by the Engineer Surveyor-in-Chief, Board of Trade, in the following words in connection with a marine accident:—"This vessel had only one boiler and was disabled through the lower manhole door joint giving out. The inner edge of the end plate and the flat surface of the door were worn to such an extent that it was difficult to make a good joint. The condition of such doors is often overlooked when the boiler is being examined, but it is very necessary, especially in old boilers, that attention should be given to ensure that they are not worn or wasted by corrosion."

THE Forestry Branch of the Dominion Department of the Interior has just issued Bulletin No. 78, entitled "Some Commercial Softwoods of British Columbia." The object of the Bulletin is the publication of figures for strength tests of eight British Columbia woods, namely, Douglas fir, Sitka spruce, Western hemlock, Western larch, Western yellow pine, Engelmann spruce, amabilis fir, and Western (red) cedar. Figures for static bending, impact bending, compression parallel with the grain, compression perpendicular with the grain, hardness, shearing parallel with the the grain, cleavage, tension perpendicular with the grain, shrinkage, and specific gravity are given. These are given in detail in ten tables—one for each of the properties mentioned—each table listing the figures for the eight species, and these tables are also summarised in one table—Table II. —inserted at the end of the volume. The nature of the tests is explained and illustrated by diagrams, and a glossary explaining the technical terms used and the significance of the different tests is included. The results are also represented graphically in a series of diagrams, and short descriptions of the woods tested are given.

Miscellanea.

SILVER has been discovered at a place 80 miles to the north of Hailar, Manchuria.

TRIAL borings are to be put down in the Isle of Axholme, Lincs., with the hope of finding coal.

A GRAIN elevator is to be erected at New Westminster, British Columbia, at a cost of 700,000 dollars.

A COMPANY has been formed to develop the ochre deposits near Avoca, in County Wicklow, Ireland.

A SEAM of coal from 7ft. to 10ft. thick has been discovered at Estevan, Saskatchewan, and is being worked from the surface.

PRELIMINARY plans for the Passamaquoddy Bay hydro-electric tidal power development, New Brunswick, are to be completed within a year.

IT is reported that a new coal seam has been discovered on the land of the Alapaefsk Mining Concession in the Urals. It has an average thickness of from 1½ to 2 metres.

A PAPER mill which, it is said, will be the largest in the world, is to be constructed on the Campbell River, British Columbia. The output of newsprint is to be 1000 tons a day.

THE town of Dartmouth is making preparations to celebrate in a fitting manner in August, 1929, the bi-centenary of the death of Thomas Newcomen, who was born there in 1663.

IT is proposed to introduce legislation for the taxation of motor vehicles in South Africa, by which each vehicle will be charged £2, plus 1s. per horse-power, plus 2s. per 100 lb. of weight.

AN experimental parcel of 25 tons of antimony ore has been shipped from Fredericton, New Brunswick, to this country. It is proposed, however, to put down electrical plant for the production of metallic antimony at the Lake George Mines.

IT is stated that a scheme for a new deep-water dock for the Tees, to provide berthing facilities for large ocean-going liners, is under consideration by the London and North-Eastern Railway and the Tees Conservancy Commission. It is stated the project may involve an outlay of £2,000,000.

THE construction of the new central passenger terminus of the Canadian National Railways, at Montreal, will probably be started in the spring of 1929. Three years will be required to complete the terminus, although it is likely that partial completion will permit of some trains entering the station from the south toward the end of 1930.

THE recent order of the Canadian Department of National Defence for aeroplanes costing 500,000 dollars has been supplemented by additional orders totalling 550,000 dollars. The planes will be used in different civil air operations, and they comprise twelve Moths, eleven Fairchilds, four Vickers-Vikings, seven Vedettes, and two others.

AN old factory beam engine, which was made in 1814, has been working continuously since 1827 at the silk mill in Tancred-street, Taunton, of Messrs. James Pearsall and Co., and is still in excellent order, has just been replaced by a 25 horse-power electric motor, which takes its power from the mains of the Taunton Corporation. The beam engine is not, we understand, by any means worn out yet, but has been displaced solely because the electric motor is more efficient.

IT was announced at a meeting of the Council of the Cornish Institute of Engineers on December 17th, Mr. Thomas Berryman presiding, that the Royal Geological Society of Cornwall, the Royal Cornwall Polytechnic Society and the Cornish Chamber of Mines, were desirous of joining in a formal invitation to the Institute of Mining and Metallurgy to hold its summer meeting at Camborne next year, and that the Royal Institution of Cornwall would probably also co-operate.

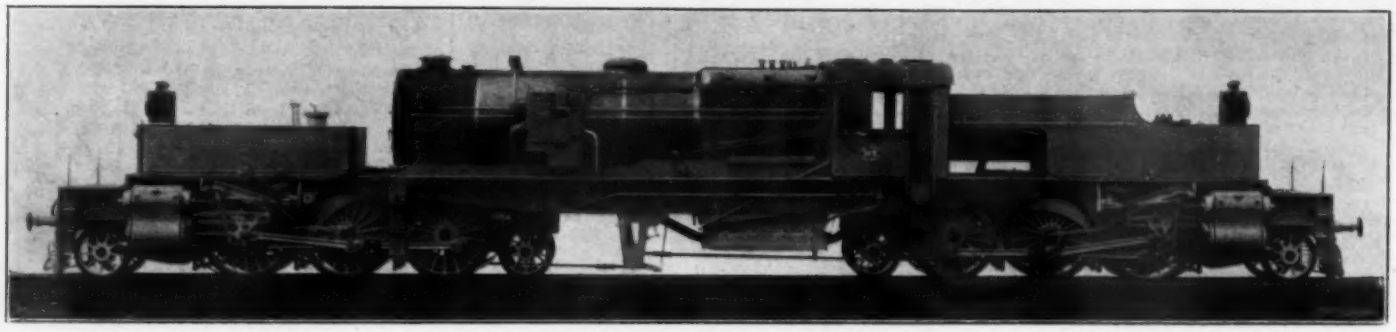
IN connection with the policy of industrial development which the Union Government is pursuing through the activities of its Board of Trade and Industries, the South African Electricity Supply Commission, acting in close co-operation with the Board, has lately established a special Division of Industrial Research for the purpose of advising manufacturers and industrialists as to the possibilities of establishing themselves in South Africa. Information on the subject can be obtained at the office of the High Commissioner for the Union of South Africa, Trafalgar-square.

AT least 1100 water falls of varying size have been reported for all Brazil, and rough surveys of them have resulted in an estimated capacity of 2,500,000 H.P. The rainfall is fairly uniform, so that streams maintain a reasonably constant flow, and the construction of storage ponds is not difficult. The State of Rio Grande do Sul is planning the erection of an 80,000 H.P. station on the Jacuhy River, in order to supply light, heat and power to Porto Alegre and the neighbouring towns. This plan has been retarded because of unsettled political conditions, but is now receiving serious consideration.

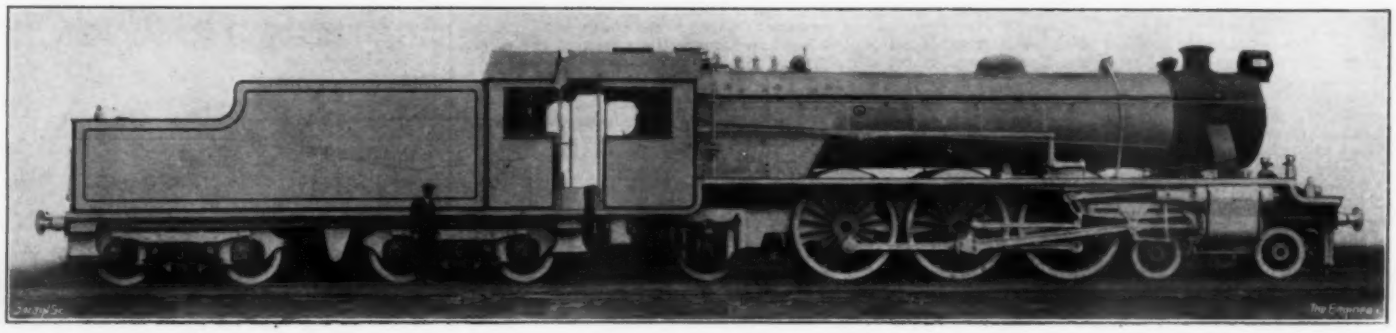
ARRANGEMENTS have been made for the Deptford East and the Bow power stations of the London Electric Supply Corporation and the Charing Cross Electricity Supply Company, Ltd., respectively, to be transferred to the London Power Company, Ltd. This step completes the arrangements contemplated under the London Electricity (No. 2) Act of 1925 for the co-ordination and control of the several power stations belonging to the group of ten companies associated with the London Power Company. Of these stations that at Horseferry-road has been closed down and arrangements are being made to take a similar step as regards Alpha-place, Wood-lane, and Richmond-road. Considerable progress was made during the past year with the extensions to and interconnection of the remaining stations. It is expected that the first section of the new Deptford West station will be available for commercial service early in 1929. Very careful consideration is being given to the design of the new station at Battersea, which was sanctioned by the Electricity Commission last autumn.

SOME LOCOMOTIVES OF 1927

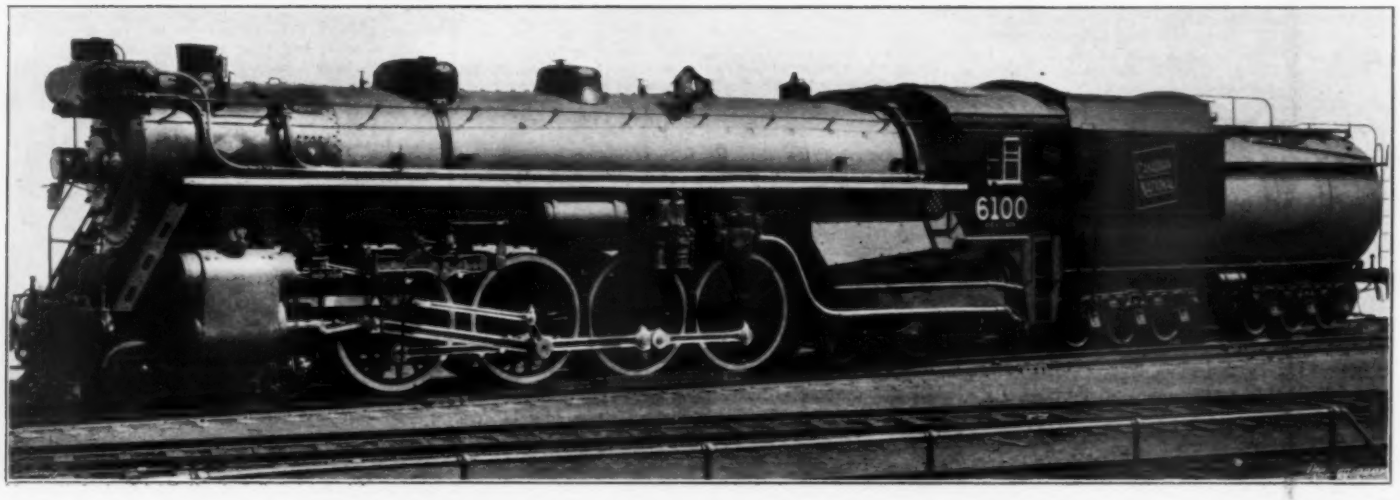
(*For description see page* 18)



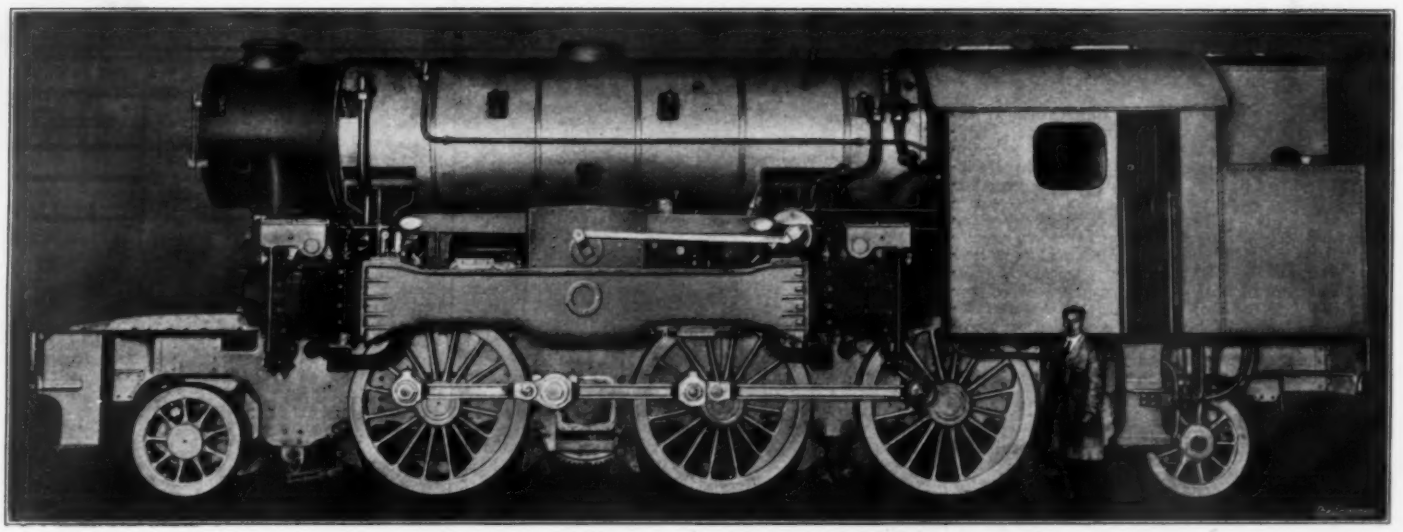
SAN PAULO RAILWAY—GARRATT LOCOMOTIVE—BEYER PEACOCK



BROAD GAUGE ENGINE FOR INDIA—VULCAN



CANADIAN NATIONAL RAILWAYS—PASSENGER LOCOMOTIVE



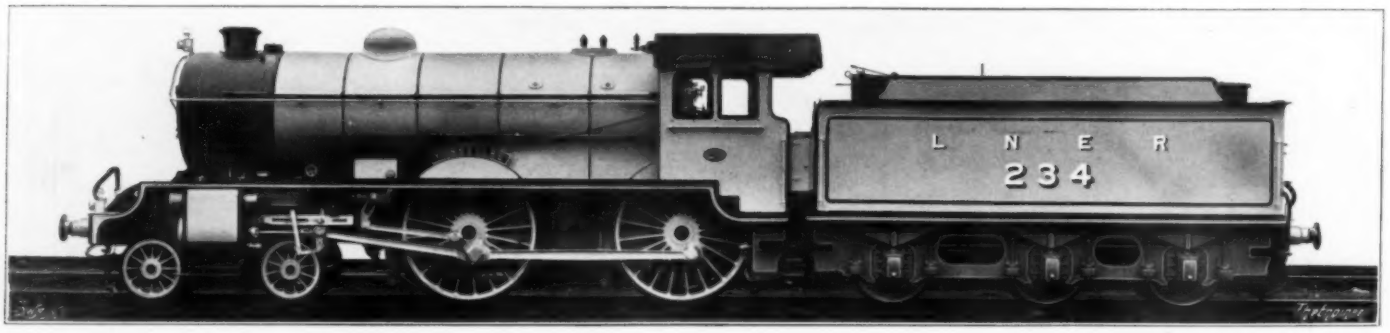
THE KITSON-STILL STEAM AND INTERNAL COMBUSTION LOCOMOTIVE

ELECTRICAL ENGINEERING IN 1927

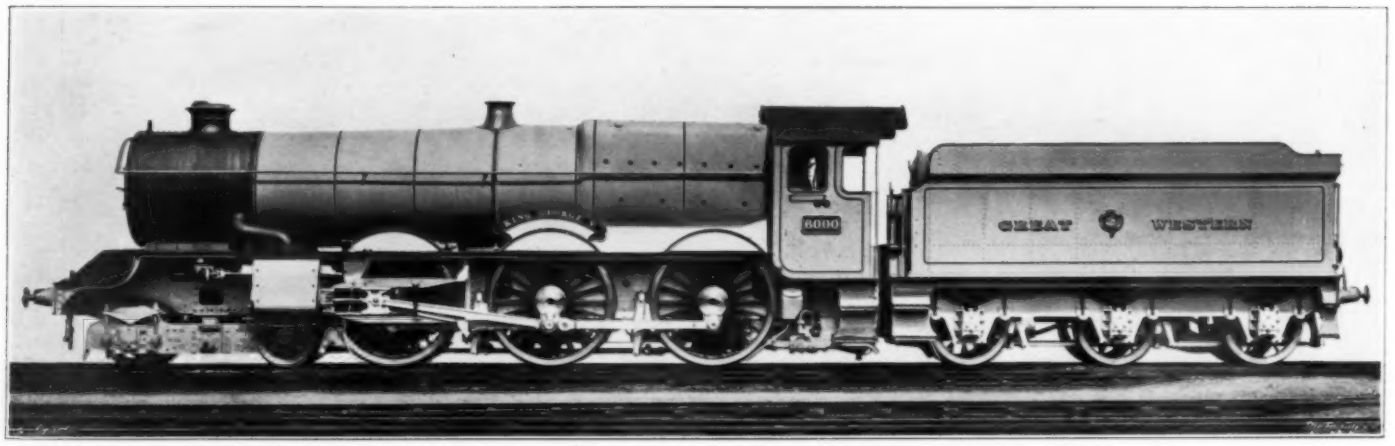
22,500 kVA Turbo-Generators at Stourport

10,000 Kilowatt Turbo-Generator at Poplar

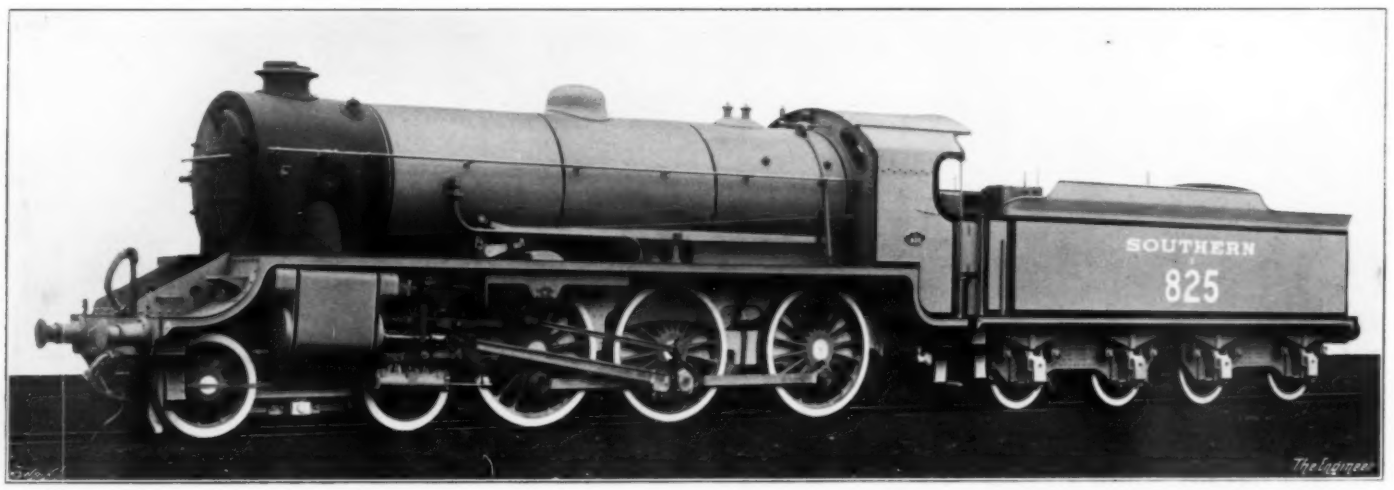
SOME BRITISH LOCOMOTIVES OF 1927



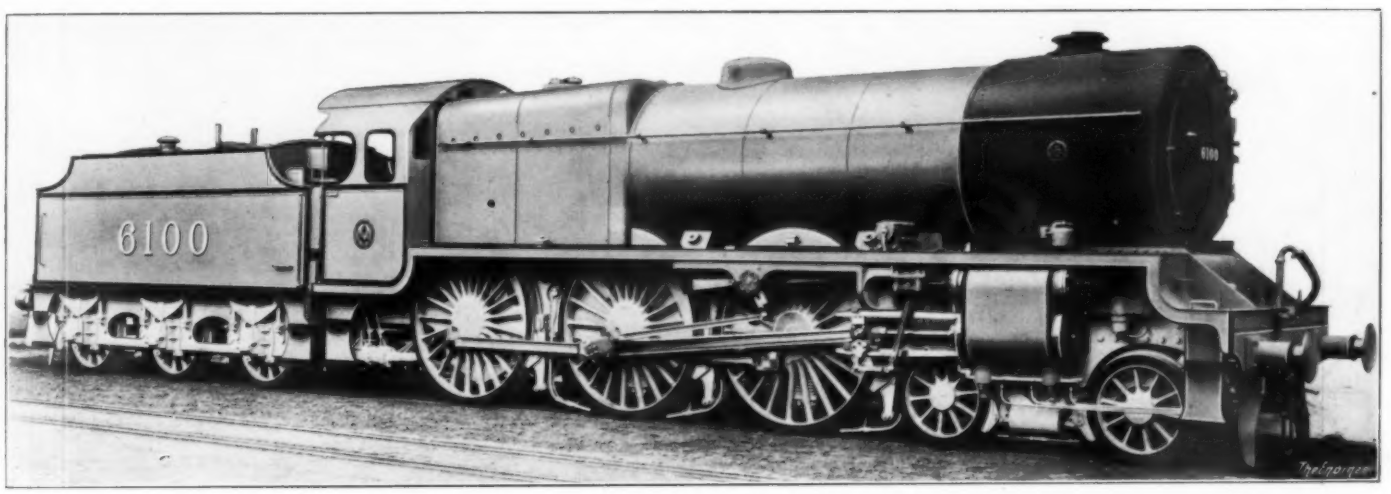
L. AND N.E. RAILWAY—THREE-CYLINDER LOCOMOTIVE



G.W. RAILWAY—FOUR-CYLINDER EXPRESS LOCOMOTIVE

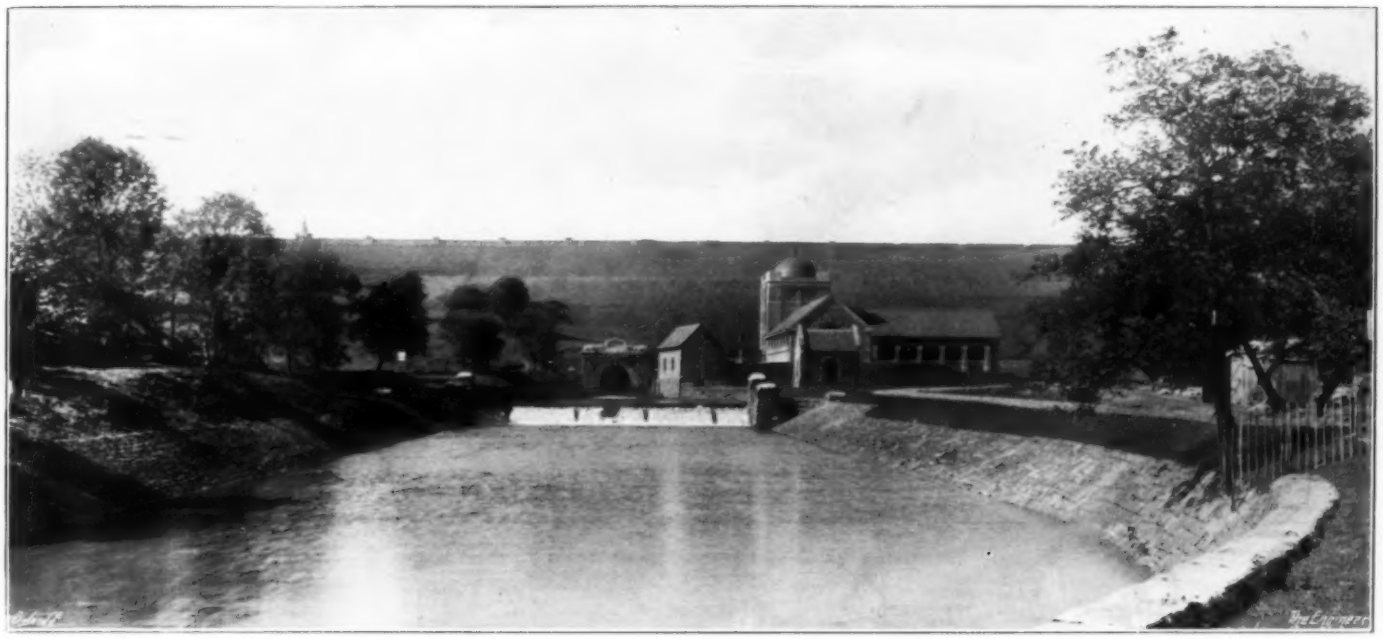


SOUTHERN RAILWAY—EXPRESS GOODS ENGINE



L. M. AND S. RAILWAY—THREE-CYLINDER EXPRESS LOCOMOTIVE "ROYAL SCOT"

SOME CIVIL ENGINEERING WORKS OF 1927

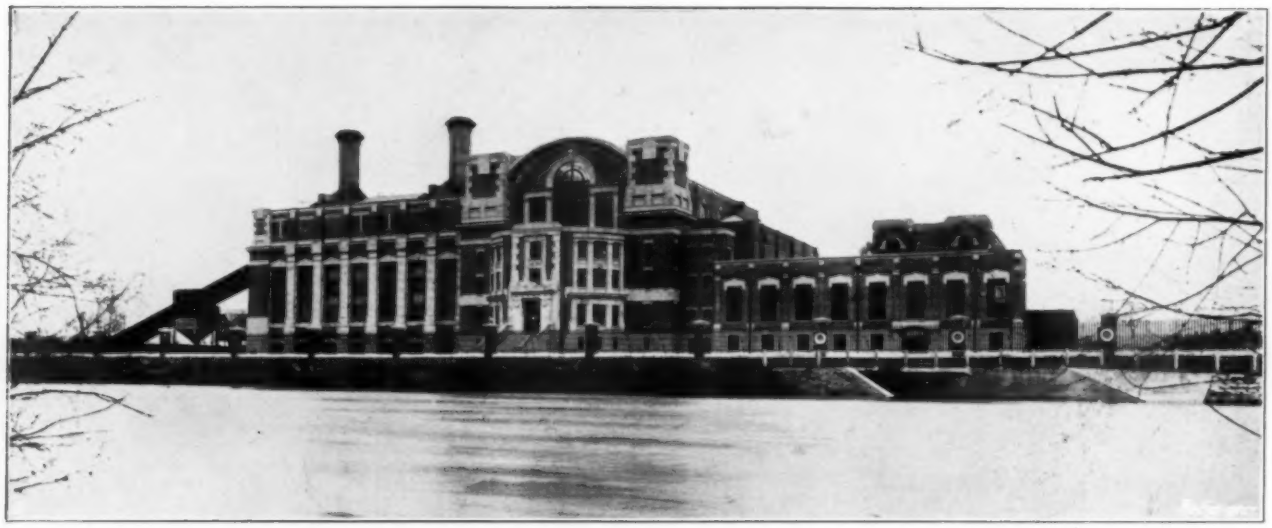


Taf Fechan Reservoir—Embankment, Outlet Works, and Filter House

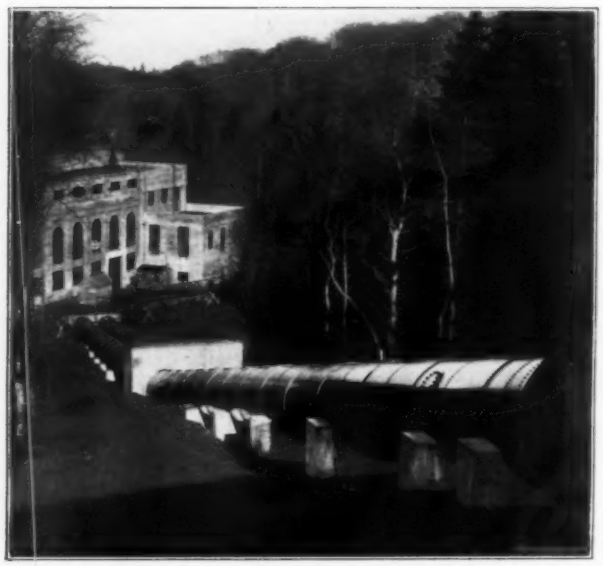
Gladstone Docks, Liverpool

Gatineau River—Farmers Rapids and Chelsea Dams

ELECTRICAL ENGINEERING IN 1927

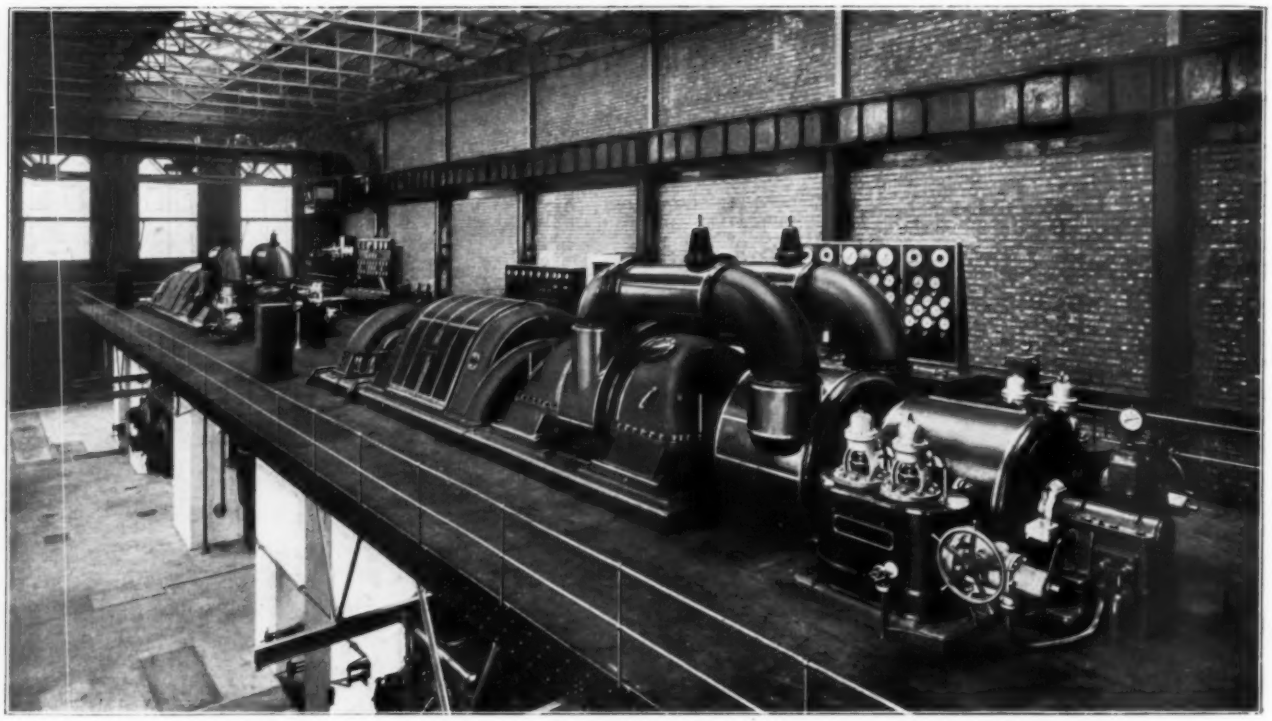


EXTERIOR VIEW OF THE STOURPORT ELECTRIC POWER STATION



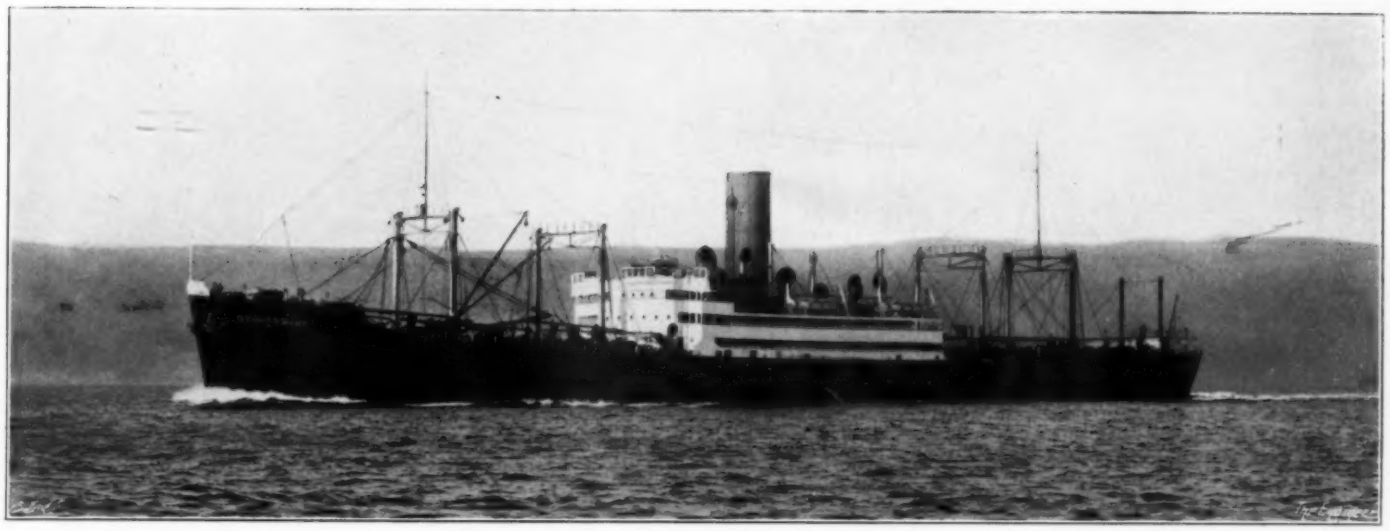
BONNINGTON HYDRO-ELECTRIC STATION

STONEBYRES HYDRO-ELECTRIC STATION

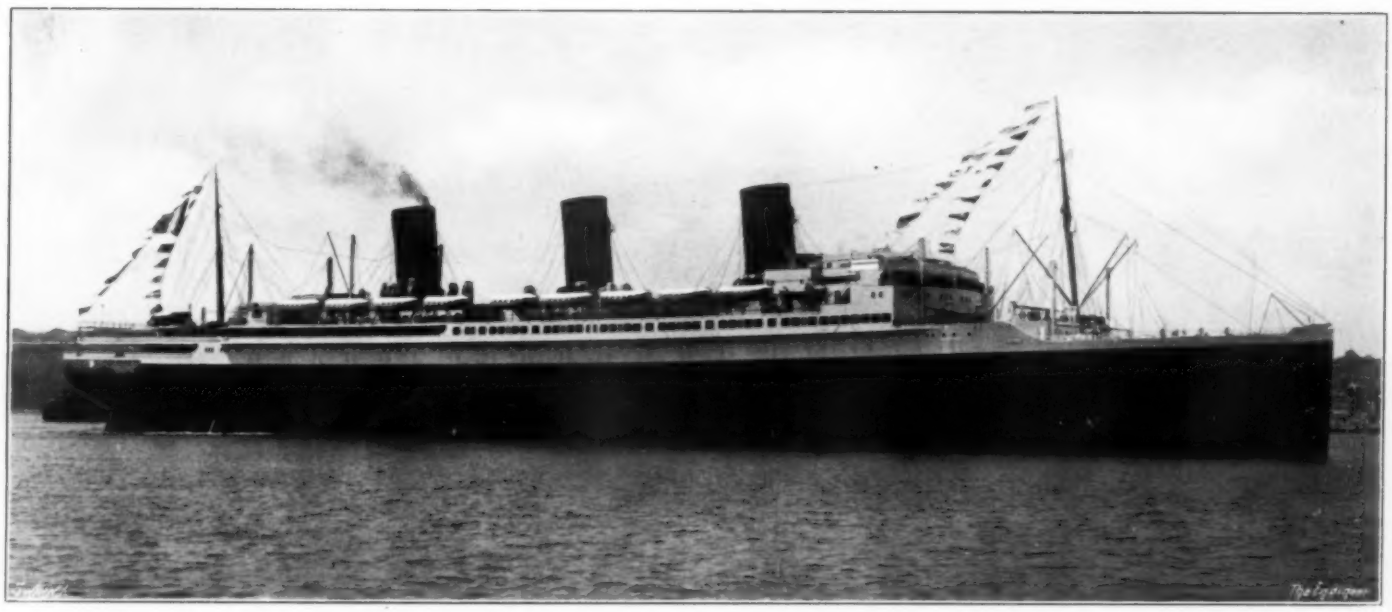


INTERIOR OF TURBO-GENERATOR HOUSE OF THE FERRYBRIDGE ELECTRIC POWER STATION

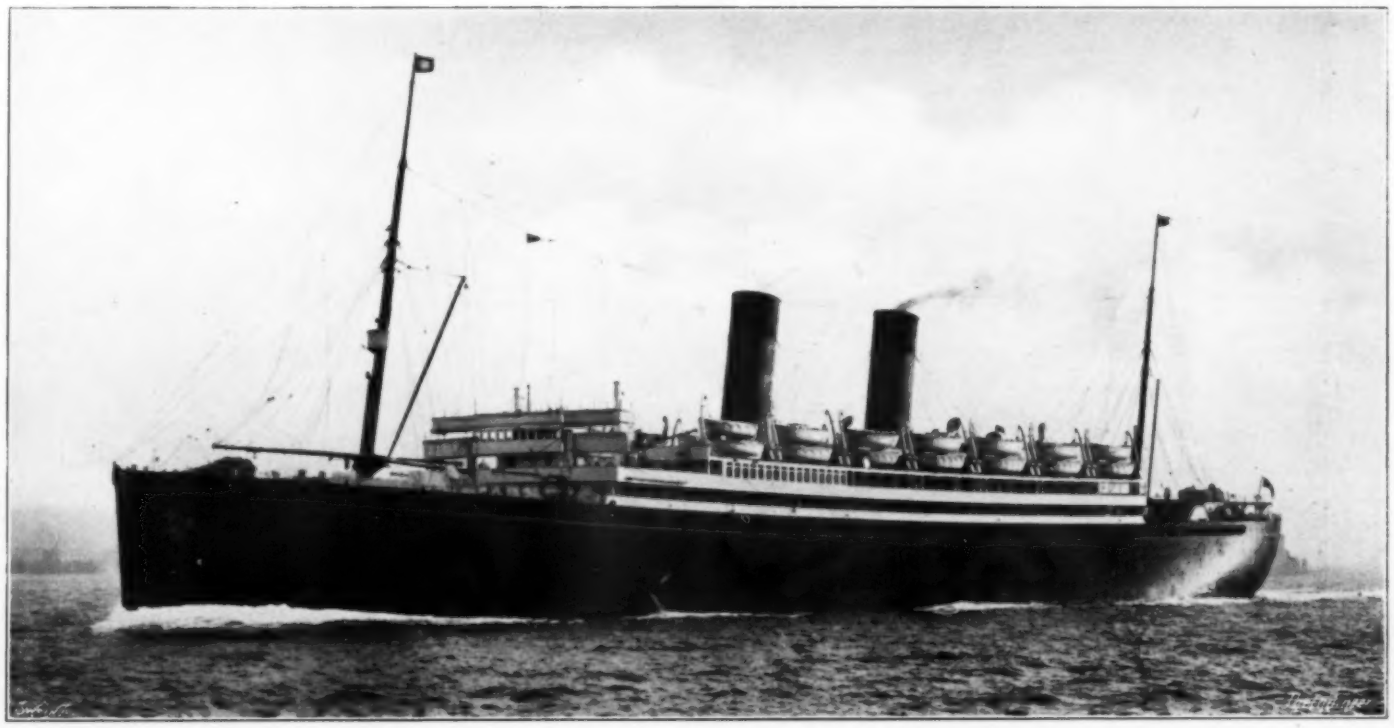
SOME STEAMSHIPS OF 1927



THE CANADIAN PACIFIC CARGO SHIP BEAVERBURN



THE FRENCH LINER ILE DE FRANCE



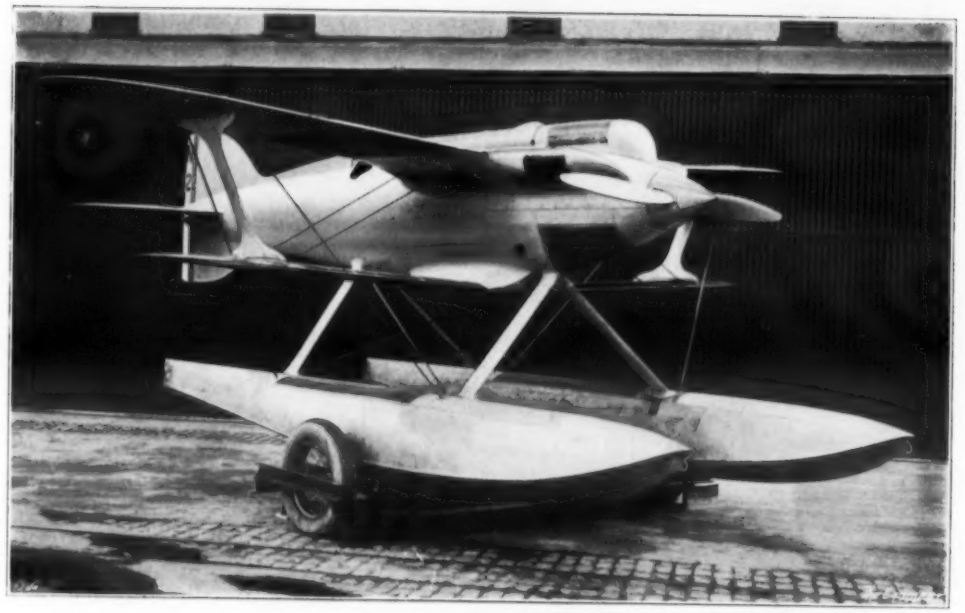
THE WHITE STAR LINER LAURENTIC

SOME AEROPLANES OF 1927

FAIREY IIIF SEAPLANE

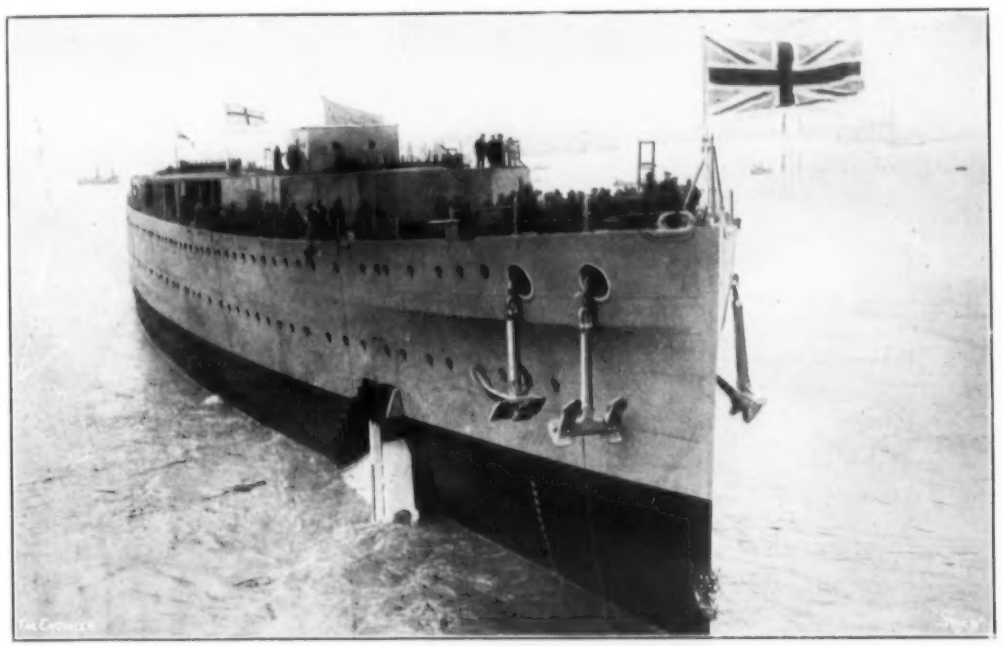
WESTLAND WAPITI GENERAL SERVICE MILITARY MACHINE

VICKERS VALIANT GENERAL SERVICE MILITARY MACHINE

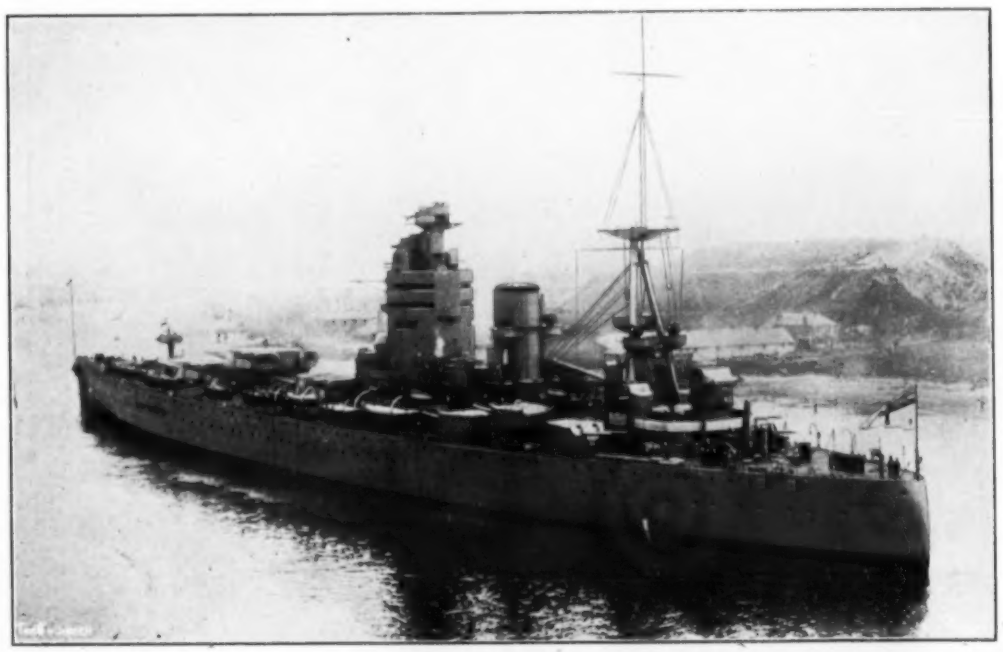


GLOSTER IV. RACING SEAPLANE

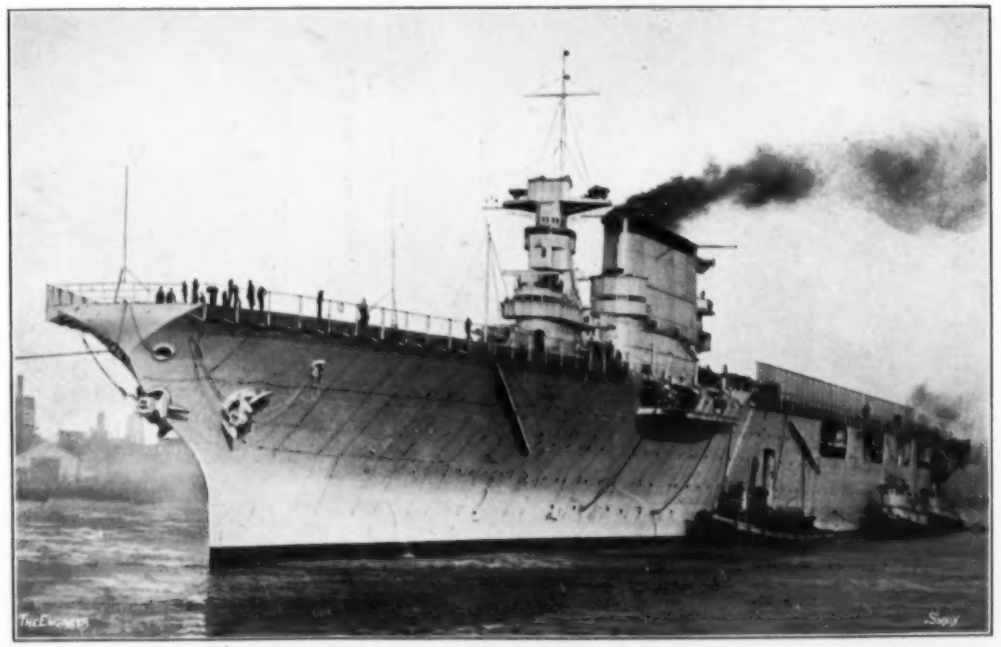
H.M. 1ST CLASS BATTLESHIP RODNEY



H.M. ARMOURED CRUISER LONDON



H.M. 1ST CLASS BATTLESHIP NELSON



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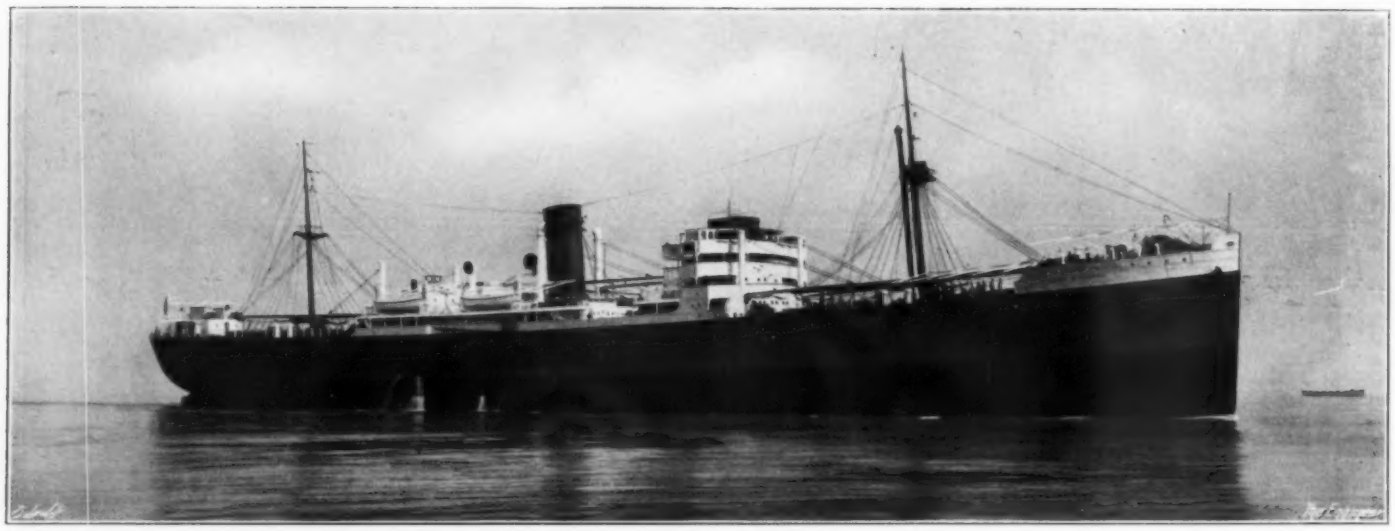

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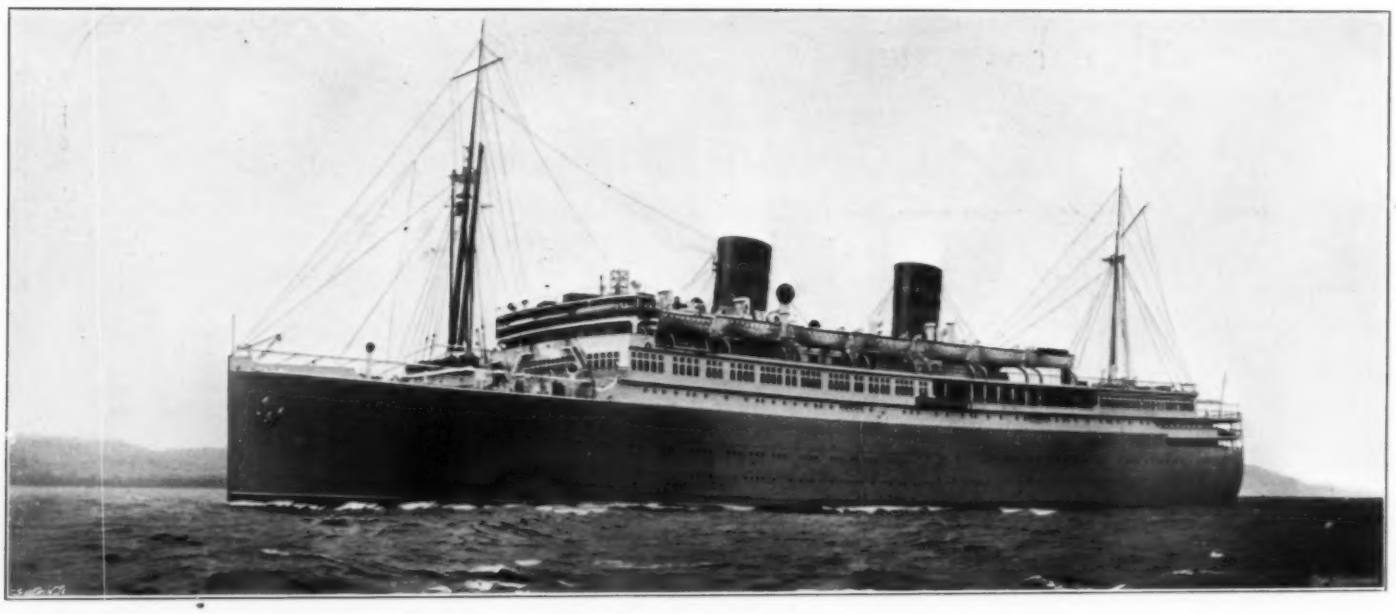

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THE ENGINEER.

JANUARY 6, 1928.

1927—A Retrospect.

IF it may be said of years as of nations "Happy are they that have no history," then 1927 must be accounted the best that this country has known for many a day. Our international relationships gave no cause for anxiety, and, at home, we enjoyed a period of industrial peace to which it would be hard to find an equal. Labour, repenting of the folly into which it fell in 1926, showed, not only a disinclination to pursue disputes, but, as though it were anxious to make up for the harm it had done, exhibited an unexampled desire to come to terms with Capital for the common good. We must not hastily assume that this behaviour heralds a new temper in trades unionism. The early morning repentance of the follies of a night is rarely permanent; it departs with the headache, and, as the emptied pockets refill, the sinner once more courts temptation. Yet in this case at least some good has been done. Under the influence of depleted coffers the unions have, on the one hand, rejected a violent policy and, on the other, have endeavoured to understand the economic position. Even if we dare not expect that in all coming years we shall enjoy such industrial tranquillity as in that just closed, yet, in such disputes as we may have to face, we shall be supported by the knowledge that Labour and Capital had for a few months been very near to each other, and we may hope that the greater sympathy and mutual understanding which was gained in that intercourse will reduce the asperity of the conflict and make its long continuance less probable. In the last few weeks of the year the General Council of the Trades Union Congress accepted an invitation from a group of employers to meet at a general conference with the object of seeking a basis of co-operation. A conference of the kind, initiated, not because of a dispute, but at a moment when both parties are on friendly terms, can scarcely fail to encourage that spirit of toleration on both sides which is the fundamental necessity of a lasting understanding. We may be certain that Capital and Labour will leave the conference room knowing more of each other's difficulties and aspirations, and it is fair to hope that a means will be found, by reasonable give and take, to satisfy as far as economic facts will permit, the desires of both.

In the field of industry no more important measure has received the Royal Assent within recent years than the Trades Disputes Act of 1927. Whether it was the direct outcome of the Great Strike or not, it was certainly accelerated by that disaster. In those few mad weeks of May, 1926, the ills of the 1907 Act were made manifest and the repeal of that measure became imperative. There were three essential provisions in the Bill brought forward by the Government. First, that a general strike was illegal; second, that picketing with intimidation was illegal; and third, that a compulsory levy for the political funds of a union was illegal. The Bill was violently opposed by the Labour Party in the House of Commons, but there is no doubt whatever that it had the sympathy of the majority of the working classes—many of whom were involuntary sufferers in the Great Strike—and the passage of its principal clauses was never in doubt. That the country as a whole rejoiced at the passage of the Act need hardly be said. It had always regarded the old Act as a political manœuvre carried out to curry favour with Labour, and it saw its repeal effected with feeling of profound relief.

Freed from the anxieties and disturbances of strikes and lock-outs, the engineering industry made steady progress during the year. In some trades, particularly the electrical and automobile, there was ample work, and in general engineering the slump had all but disappeared. Nearly all factories had a fair amount of work and some were as busy as could be. Shipbuilding was active throughout the twelve months, as the total tonnage of about 1,300,000 tons for the United Kingdom shows. On the other hand, the locomotive trade continued to be bad and several companies had barely enough work to keep the shops running. On the whole, however, employers had little to complain of in the amount of work. Unfortunately, as much cannot be said with regard to profits and prices. The burden of taxation is grievous upon the land and some means of relieving it is the most urgent necessity of the day. The Government promises economy, but fails to practise it, not perhaps because it itself is unwilling, but because every measure of reform is combated in the House of Commons. We are paying for a huge bureaucracy. Each Ministry or Department may be able to show that it is performing useful work, but there is no evidence that the same work could not be done without it. The Government's intention to dissolve the Ministry of Transport and the Departments of Mines and Overseas Trade was not carried out, and there is no indication that it is likely to be fulfilled at an early date. Such bodies are always able to give reasons for their continued existence and to find supporters. Against them must be brought the unceasing demand from the public, and particularly from great manufacturing industries, for diminished public expenditure and reduced taxation.

During the year not a little was heard about tariff reform and a rebate scheme introduced by the British Associated Heavy Steel Makers to discourage the purchase of steel abroad was energetically debated. Unfortunately, the heavy steel trade remained in a very bad position throughout the twelve months and shows as yet little or no signs of recovery. It can no longer be said that our works fail to meet overseas competition because they are less well equipped than those of foreigners. We have now many that leave nothing to be desired either in lay-out or mechanisation, and yet they are short of orders. The real source of the trouble appears to be the difference between the wages and hours in this country and those in Belgium and Germany, and on top of all excessive taxation. Under these conditions it is impossible for British steel firms to produce economically at the low prices of their competitors. At a dinner given by the National Federation of Iron and Steel Manufacturers in June, the President, Mr. H. C. Bond, gave some striking figures. He showed that local rates per ton of steel plates amounted to no less than 4s. 7d., as compared with 1s. 7d. in 1913, whilst the cost of social services, imposed upon the industry by statute, had risen from 1s. 7d. per ton in 1913 to no less than 4s. 3d. per ton in 1927. In other words, every ton of steel plates produced in the United Kingdom has to bear a burden in local and national taxation of 8s. 10d. What is true of steel plates is, of course, true of other products of industry. Such figures as these give us a very striking picture of the burden which excessive taxation is imposing upon the trade of the country.

In the quest for an issue out of their afflictions the engineering and allied industries are examining two methods. By one of these methods, which is

known as "rationalisation"—a not very happy pseudonym for a form of co-operation—it is hoped to reduce the costs of manufacture, and by the other, which is called "improved marketing," it is sought to stimulate the potential purchasing power of the world. Under the rationalisation scheme the various units of an industry sign a restrictive covenant. Each firm agrees to make only certain types of machines and not to enter into competition with companies making other types. In the machine tool industry, to take an example from German practice, one firm makes nothing but wheel lathes and no other firm—within the scheme—also makes them. The result is that that firm receives all the orders for wheel lathes and is, in consequence, able to produce them more cheaply than if it received only one or two orders now and then. Another firm makes nothing but vertical boring machines, another nothing but certain types of lathes, and so on. There is nothing new in this scheme. Its advantages have been appreciated for many years, and there are examples of it in operation in this country, amongst which the A.G.E. may be cited. It is an ideal to which engineers may with longing turn their eyes, but there are vast difficulties in the establishment of it, amongst which not the least are those set up by financiers. It is obviously impossible to organise a number of firms for rationalisation without financial changes of no small amount, and sometimes, as in the notable recent case of the Vickers-Armstrong amalgamation, enormous sacrifices of capital.

The other plan to which we have referred would be easier to put into practice, but the mode of operation is less clearly definable. During and since the war the capacity for production has increased at a far greater rate than the actual consumption. Unless it is possible to augment the demand for engineering products we shall be forced to the conclusion that, in Europe particularly, the existing capacity is too great and we shall have to witness a gradual reduction in number and size of factories. In America, with its vast undeveloped areas and small population per square mile, the difficulty does not exist. The power of absorption of engineering products is unlimited. But in Europe, with its much denser population, it is far harder to secure markets. As a consequence we find Germany, Italy, Switzerland, Sweden, and even Czecho-Slovakia competing for our home markets as we are for theirs. The supply exceeds the demand at present prices. The object of the improved marketing scheme is to encourage buyers, but the exact course that is to be taken with that end in view is not prescribed.

As far as potential markets are concerned, Great Britain is better situated than any other nation. It has the whole Empire as a field for its products. But although some approach to Imperial rationalisation has been made, we are yet far from the position which might be attained. What is needed is a unified Empire for purposes of trade. We are convinced that such unification is not an impossible dream, and we believe that it requires no more than the genius of some commanding personality to weld every part of the Empire into a commercial union which would accelerate the welfare and prosperity of every part.

Technical Progress.

Following our usual practice, we devote the greater part of this issue of THE ENGINEER to a review of the technical progress made during the past year. No one can read those pages without feeling that, despite its manifold difficulties, all branches of British engineering gave evidence of vitality and progressiveness, and when the facts are set down one by one we cannot but be astonished by the vast amount of admirable work that was done. That is one advantage of such an Annual Review. Week by week engineering products and works are recorded in our columns and in the columns of our technical and even our lay contemporaries; but it is only when we see a panorama of them all that we are able to appreciate the magnitude of the engineering industry and profession.

It would be invidious to pick out any one branch of industry for especial mention, but we cannot refrain from directing the attention of our readers particularly to those sections of our review which deal with marine engineering, aeronautics, and locomotive development. In marine engineering the continued progress of the internal combustion engine is quite remarkable. It is estimated that at this day one-third of the total propulsive horse-power afloat is generated by oil engines. When we consider how short a time—barely sixteen years—has elapsed since the first motor ship, the Vulcanus, made her maiden voyage, we must admit that development has proceeded at a rate for which but few parallels in mechanical engineering can be found. Moreover, there appears, despite rumours that the steam engine is returning to favour, to be no abatement in the demand for motor vessels, and even larger and larger engines are in contemplation. In 1914 the world's motor ships classed in Lloyd's Register amounted to half a million tons; in 1926 it had risen to nearly 3½ million tons, and last year rather over half a million more tonnage was added.

In the field of aeronautics, which is approximately the same age as the motor ship, our review shows that Great Britain holds a position second to none. The advance is continuous and steady, both in the technical design and manufacture of planes and airships and in their achievements. We must remind our readers, too, that our record is never complete. Indeed, as far as machines adopted by the Air Ministry are concerned, it is safe to say that those we are permitted to describe are always a little out-dated by others about which official secrecy has to be observed.

Finally, a word with regard to locomotives. There never was a time when the improvement of the steam locomotive was pursued with so much energy. The old charge of inefficiency is rapidly becoming groundless. When a locomotive can develop a draw-bar horse-power hour for the consumption of about 2½ lb. of coal it may justly claim to be an economical machine. Recent improvements effected largely by the use of higher pressures, have placed the steam locomotive in a better position than ever and made its supersession by the electric locomotive less likely. At the same time, steady progress is being made with the oil engine-driven locomotive, and all engineers in this country are watching with the liveliest hopes the development of the Beardmore engines and the even more novel arrangement for which Kitson and Co., Ltd., are responsible

Prime Mover Locomotives of 1927.

TAKEN for all in all, the year was an exceptionally interesting one in the history of prime mover locomotives—that is to say, all types of locomotives save the electric. In normal designs it saw the introduction of a class on the L.M. and S.R. of which Sir Henry Fowler may be justly proud, and amongst novel designs first place must be given in this country to the Kitson-Still engine, which was completed in December by Kitson and Co., Ltd. In Germany the Schmidt super high-pressure engine and a powdered fuel locomotive were amongst the most remarkable of the year. Of all these engines, save the first, it is, as yet, too soon to speak with a certain voice. We do not know what their future may be, and only one of the three, the Schmidt engine, has so far been exhaustively tested. With it we shall deal at some length in an approaching issue. British locomotive men who have seen it speak well of it; there can be no question that it is a fine piece of mechanical engineering, and that it has an exceptionally low coal consumption per ton-mile is shown by test results. But whether the economies that it can ensure are worth the extra complication and prime cost cannot yet be said with certainty. Sir Henry Fowler's simple three-cylinder engines, which haul the "Royal Scot" train approach it in lowness of coal consumption, and Sir Henry's belief that he could do even better with a compound is scarcely a secret. For engines notable mainly for their size we must look to the New World, and in that connection we are able to record with satisfaction that Canadian firms are now rivalling the great builders of the United States.

The London, Midland and Scottish.

In our issues of August 5th and October 7th we dealt with the three-cylinder locomotive Royal Scot, the second of the two articles containing not only a plate drawing of the engine, but a page drawing of the tender as well. To-day, in one of our Supplements, a photograph of the engine is reproduced, and in Fig. 1 we give the weight diagram. She has three cylinders 18in. by 26in. driving 6ft. 9in. six-coupled wheels, and she weighs complete with her tender 127 tons 12 cwt. The total heating surface is 2081 square feet, and the superheating surface 445 square feet; the grate area is 31·2 square feet. With a boiler pressure of 250 lb., the tractive effort at 85 per cent. is 33,150 lb. As Sir Henry Fowler showed in some tables given in the discussion at the Institution of Mechanical Engineers on December 16th, this engine draws trains of 450 tons and over non-stop from Euston to Carlisle at an average speed of 53 m.p.h., for a consumption in the neighbourhood of ·074 lb. per ton-mile—a remarkably good figure. In our issue of December 23rd we gave tables which showed how well she compares with both simple and compound predecessors.

Another notable addition to L.M.S. locomotives is a group of three Garratt engines, built by Beyer, Peacock and Co., Ltd., which were delivered early in the year. They are, as will be seen from the photograph which we reproduce in Fig. 2 and by the weight diagram—Fig. 3—given below of the 2–6–6–2 type,. They are not so powerful as the three-cylinder "Garratt's" on the L. and N.E. Railway, but, nevertheless, are large engines weighing in working order 148 tons 15 cwt., and able to exert a tractive effort at 85 per cent. boiler pressure of 45,620 lb. The two cylinders in each engine are 18½ by 26, and the working pressure is 190 lb.; the driving wheels have a diameter of 5ft. 3in. The boiler is large; it has an evaporative surface of 2137 square feet and a superheater surface of 500 square feet. It is of interest to note that whilst these figures are not much greater than the corresponding dimensions for the "Royal Scott" class, namely, 2081 and 445, the grate area is 44·5 square feet against 31·2 square feet in the express engines. It will be recalled that Mr. Gresley's "Garratt" was designed especially for banking service at Wath, but we understand that Sir Henry intends to use his for long-distance work.

An interesting addition to the tank engines of the company is a class of twenty-five which will be numbered 2300 to 2324. The first only left the Derby shops in the middle of December, when three or four more were practically ready for delivery. A photograph of the class is not yet available, but we are able to give a diagram, Fig. 4. They have two 19 by 26 outside cylinders, driving 5ft. 9in. coupled wheels, and with 85 per cent. of the boiler pressure, which is 200 lb., they develop a tractive effort of 23,125 lb. The evaporative surface is 1220·25 square feet, the superheater surface, 266·25 square feet; and the grate area, 25 square feet.

Towards the end of the year work was begun upon a group of 4–4–0 passenger engines, but none of them are yet completed. They belong to the "No. 2" class of Midland passenger engine, modified.

During the year the company put into traffic on the Northern Division thirteen "Sentinel-Cammell" steam rail motor coaches. No photographs or diagrams of these vehicles are yet available, but the leading particulars are as follows:—

Cylinders, two high-pressure	6½in. by 9in. stroke
Driving wheels	2ft. 6in. diameter
Heating surface—	
Tubes	27·7 sq. ft.
Fire-box	26·7 ,,
Superheater	12·6 ,,
Total	67·0 ,,
Grate area	3·97 sq. ft.
Working pressure	275 lb. per sq. in.
Bunker capacity	23·5 cubic feet
Water capacity	300 gallons

The engine is a "Super-Sentinel" vertical, of 100 B.H.P., with two high-pressure cylinders, poppet valves, and balanced crank shaft. There is seating capacity for forty-four passengers, and ample luggage accommodation is provided. The speed of the vehicle at 500 r.p.m. of the engine is 37½ miles per hour. The boilers have been equipped with the railway company's own standard boiler mountings. The engines and boilers were built by the "Sentinel" Waggon Works, Ltd., at Shrewsbury, and were forwarded to Cammell Laird and Co., Ltd., Nottingham, to be fitted into the coaches, as that firm was building the bodies and bodies.

The Great Western Railway.

On the Great Western the engine of the year was undoubtedly Mr. Collett's "King" class, of which the first, King George V., was sent to the centenary celebration of the Baltimore and Ohio Railroad, where it attracted no little attention when it ran in the daily procession of locomotives at Halethorpe. It also made some demonstration runs with trains of over 540 tons from Baltimore to Washington and Philadelphia, and appears to have caused considerable surprise by the ease with which it took such loads. It is reported even that it exceeded the speed limit and had to be checked! It returned to this country a few weeks ago and is now in regular service. Five other engines of the class have already been built. A photograph of King George V. is reproduced in one of our supplements to-day and a diagram is given as Fig. 5, p. 20.

The "Kings" are considerably larger than the famous "Castles." They have cylinders, four in number, 16½in. by 28in., as against 16in. by 26in. of their predecessors. The boiler barrel is 16ft. long, against 14ft. 10in., and is 3in. greater in maximum diameter. The total evaporating and superheating surface is 2514 square feet and the grate area 34·3 square feet. In the "Castles" the working pressure is 225 lb., in the "Kings" 250 lb., and the respective tractive efforts at 85 per cent. boiler pressure are 31,625 and 40,300 lb., but the driving wheels of the "Kings" are only 6ft. 6in., against the 6ft. 8½in. of the "Castles." The total weight in working order, engine and tender, of the "Kings" is 135 tons 14 cwt., and of the "Castles" 119 tons 17 cwt. The load on the driving wheels has been raised from about 19¾ tons to 22½ tons.

London and North-Eastern Railway.

Mr. Gresley has always something of interest for this annual review, and although he designed no new

large engine in 1927, he constructed a new type of 4–4–0 three-cylinder engine with 17in. by 26in. cylinders. The first half-dozen engines of this class, to be known as the "Shire" class, are fitted with the connecting-rod of the type, new to this country, invented by Mr. Woodard, of the Lima Locomotive Works, and used by his company on some engines for the Texas and Pacific Railroad. We give on p. 20, Fig. 6, a small drawing of the head of one of these rods. The big end is slotted and the front end of the coupling rod fits between its jaws. Through both rods a solid steel bush, held by a key in the big end, passes. This bush, in its turn, fits upon a floating bush on the crank pin. This arrangement gives a large bearing surface and allows the centre lines of the connecting and coupling rods to coincide.

The engine itself is shown by the reproduction of a photograph in one of the Supplements presented with this issue, and a weight diagram, Fig. 7, is given on p. 20. The three cylinders are in line, all in one casting, with their valve chests and, of course, all three drive the same axle. They have 17in. pistons with a 26in. stroke. Walschaerts gear operates the two outside valves, whilst the inside valve is driven by the Gresley floating gear, the levers, in this case, being placed at the back end of the cylinders instead of in front, as in the N.E.R. "Pacifics." The driving wheels are 6ft. 8in. in diameter and a tractive effort of 21,556 lb. is secured with a mean pressure equal to 85 per cent. of the boiler pressure, which is 180 lb. The boiler has an evaporative surface of 1398 square feet and a superheater surface of 246 square feet and the grate area is 26 square feet. The boiler horse-power is 1056. The total weight of engine and tender in running order is 118 tons 13 cwt. and the weight on the drivers 42 tons.

Everyone is now interested in the use of higher boiler pressures in locomotives, and there is a distinct tendency to move upwards on all lines. The increased efficiency which results from the use of higher pressures is not in doubt, but the economy, when wear and tear and general maintenance costs are taken into consideration, can only be ascertained by direct experience. With this object in view Mr. Gresley took the opportunity, offered by the fact that spare boilers have to be held in reserve, to build a few for 220 lb. pressure, and in July the Pacific No. 4480 went into service with one of them. At the same time more superheating area was provided by increasing the number of elements from 32 to 43.

Southern Railway.

Relatively little new work was done in the shops of the Southern Railway during the year, the most notable being the completion of a batch of "King Arthurs" and thirteen 4–6–0 express goods engines, which are very similar to the "King Arthurs," the main differences being the use of 5ft. 7in. in place of 6ft. 7in. driving wheels. A photograph of one of these engines is reproduced in one of our Supplements to-day.

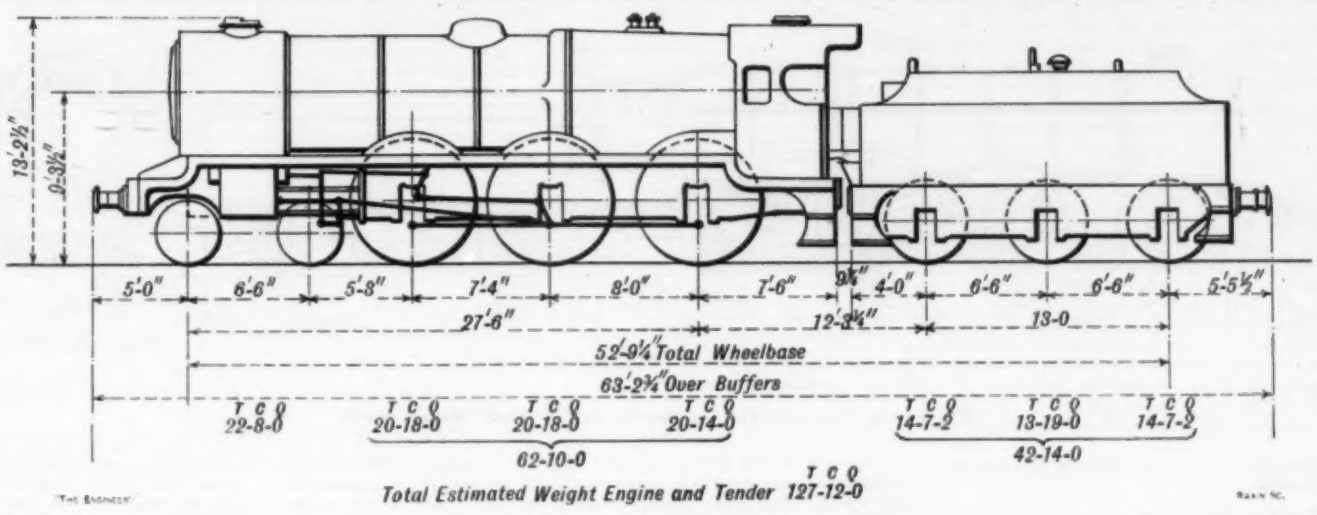


FIG. 1—L.M. AND S. RAILWAY LOCOMOTIVE ROYAL SCOT

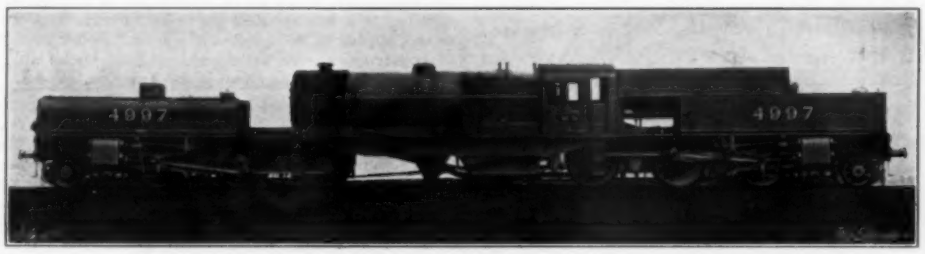


FIG. 2—L.M. AND S. RAILWAY—GARRATT LOCOMOTIVE—BEYER-PEACOCK

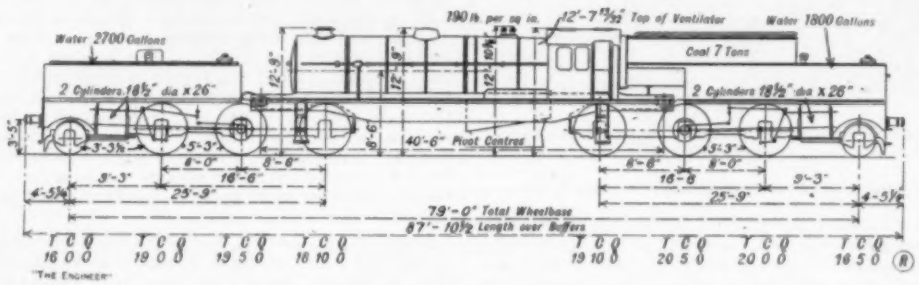


FIG. 3—L.M. AND S. RAILWAY—GARRATT LOCOMOTIVE

The Kitson-Still Locomotive.

Amongst makers' engines, the place of honour must be accorded to the Kitson-Still locomotive, which is unquestionably the most interesting British engine of the year. Unfortunately, she was only completed a few weeks before Christmas, and has only so far been run upon rollers in the shop. She has, however, shown her capabilities, as far as the conditions of the test will permit, and her makers are quite satisfied that she will give a good account of herself on the road. We are fortunately able to give a picture of her, see page 16, but we propose to hold over a complete description till it is possible to deal with her exhaustively. It will be sufficient at the present time to recall a few of the salient facts of the design. We may remind our readers that in a paper read before the Institution of Mechanical Engineers on April 8th last by Lieut.-Colonel E. Kitson Clark, drawings of the engine were given. They were reproduced in our issues of April 15th and 22nd, and for convenience we use one of them again here—Fig. 8. It is a diagram of the Kitson-Still system, and with the legend is almost self-explanatory. As far as the wheel arrangement is concerned, the engine may be regarded as quite normal; the six-coupled wheels are 5ft. diameter and the axle load is 17 tons. The starting tractive effort is expected to be 24,500 lb. In appearance the engine is noticeable mainly on account of the engine covers and the high centre line of the boiler.

The fire-box is circular, corrugated, and the barrel is therefore cylindrical from end to end. Oil fuel is used, but as the cylinder jackets are in communication with the boiler some of the heat of combustion is transferred to the water. There are eight 13½in. by 15½in. cylinders, arranged in two *vis-à-vis* groups, driving a common crank shaft, which is geared down to a jack-shaft between the first and second pair of driving wheels. The crank pins on the ends of this shaft drive the coupling-rods in a familiar way. The stuffing-box ends of all the cylinders can receive steam, whilst the opposite ends are used for internal combustion. It is the intention to use the steam only on occasion, at starting particularly, and to rely for running on internal combustion. Everyone will hope that the engine may meet with success, for it is the most daring departure from accepted practice that has been made in locomotive engineering for many a long day.

A Powdered Fuel Locomotive.

Germany is faced with a fuel problem which is unknown in this country. Here we have large supplies of excellent locomotive coal; there they have an immense quantity of lignites and poor coals. Hence they are interested in problems which do not affect British railways. One of them is the combustion of these poor coals and lignites in a pulverised form in a locomotive fire-box. For two or three years the A.E.G. studied the problem in a fixed locomotive boiler, and at length attained so much success that the German State Railways placed an order for two 2–8–0 pulverised fuel locomotives with the company.

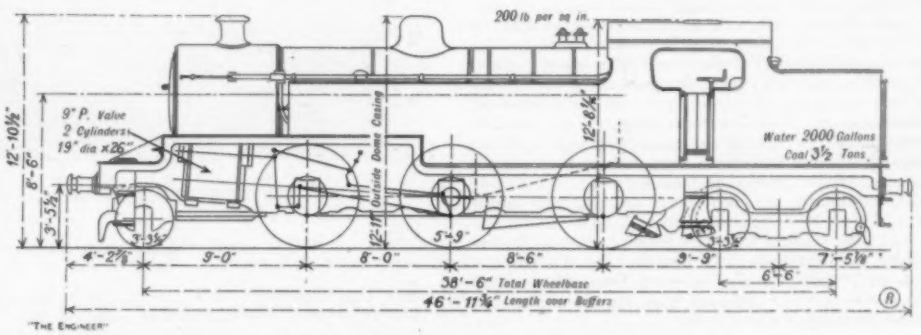


FIG. 4—L.M. AND S. RAILWAY—TANK ENGINE

The locomotive itself is practically a standard design, but it is provided with a pulverised coal container, means for conveying the coal to the fire-box, a blower

for injecting the fuel, and burners. The container holds as much fuel as will give the same mileage that solid fuel gave. Careful tests of these two engines have been made, and from them it is estimated that the haulage capacity has been materially increased.

we have already said, we shall deal fully with this engine, with drawings, in a few weeks' time, but to-day we reproduce a photograph of it—Fig. 9—and a few words of explanation may be welcome to our readers. The principal characteristic of the design is the employ-

horse-power hour, or 20 per cent. below that of normal engines of the same class.

British Makers' Engines.

By no stretch of optimism can it be said that the

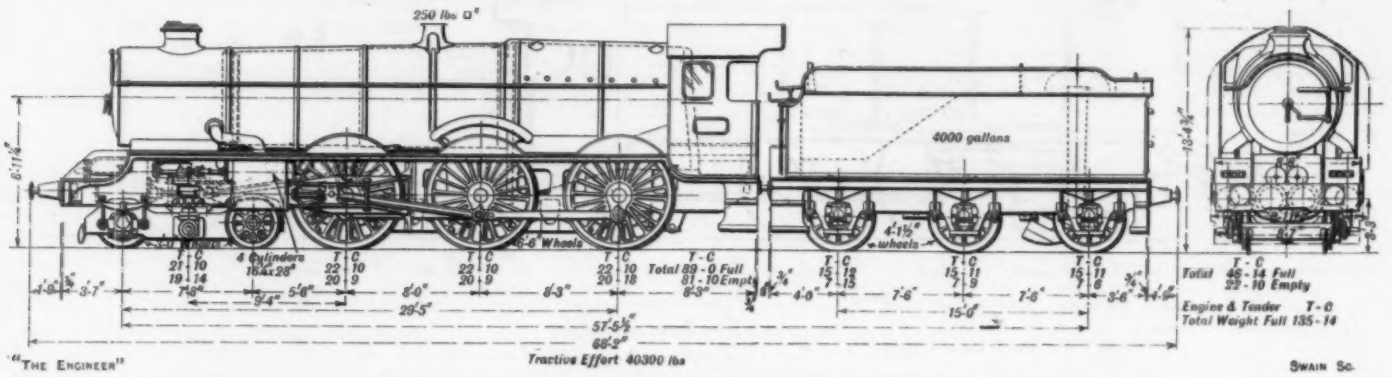


FIG. 5—G.W. RAILWAY—FOUR-CYLINDER LOCOMOTIVE "KING" CLASS

We hope to give fuller particulars of the equipment during the year.

A Huge Canadian Locomotive.

On page 16 will be found an illustration of the largest locomotive that has yet been built in Canada and in Fig. 11 we illustrate it during erection. It is one of a group of forty ordered by the Canadian National Railways for passenger and fast goods service. Ten of the engines are fitted with boosters, and will, of course, be reserved for hauling heavy loads at a moderate speed. Twenty of these huge machines are being built by the Canadian Locomotive Company, of Kingston, and the remainder by the Montreal Locomotive Works. We give below a table of particulars :—

	With booster. lb.	Without booster. lb.
Gauge	4ft. 8½in.	
Cylinders	25½in. by 30in.	
Driving wheels, diameter	73in.	
Boiler—		
Inside diameter, first course	80⅞in.	
Outside diameter, largest course	90in.	
Working pressure	250 lb.	
Fire-box	126⅛in. by 96⅛in.	
Tubes—		
No. of 3⅛in.	15	
No. of 2¼in.	27	
Flues, No. of 3⅛in.	162	
Length of tubes and flues	21ft. 6in.	
Combustion chamber, length	48½in.	
Wheel base—		
Driving	19ft. 6in.	
Engine	43ft. 10in.	
Engine and tender	82ft.	
Weight in working order—		
Engine truck	65,000	65,000
Driving	232,000	230,000
Trailing truck	91,000	83,000
Total engine	388,000	378,000
Tender	260,000	260,000
Total, engine and tender	648,000	638,000
Heating surface—		
Tubes and flues	3814 sq. ft.	
Fire-box	315 sq. ft.	
Syphons and arch tubes	117 sq. ft.	
Total	4256 sq. ft.	
Superheating surface	1700 sq. ft.	
Grate area	84·4 sq. ft.	
Maximum tractive power of engines only	56,800 lb.	
With booster	69,700 lb.	
Factor of adhesion—		
Engine	4·05	
Booster	4·5	
Capacity of tender—		
Water	11,300 imp. gals.	
Coal	20 tons	
Limiting height	15ft. 3in.	
Limiting width	10ft. 9in.	
Maximum degree of curvature engines will take	18 deg.	

It will be seen that the grate area surpasses the 70 square feet which is usually regarded as the limit for hand firing. The engines are therefore fitted with automatic stokers of the Duplex type. The shell courses of the boiler are made of high-tensile silicon steel supplied by the Carnegie Steel Company, and the main frames are of vanadium steel in twenty engines and of nickel steel in the other twenty. The Baker—a modified Walschaerts—valve gear is used, and gives a valve stroke of 9in. in full forward gear. The lap is 1 1/16 in., the lead 1/16 in., and the exhaust clearance 3/16 in. Floating bush bearings are used in several places. The feed-water heater perched on the front top edge of the smoke-box will be noticed. A common exhaust pipe is provided on the left side of the engine, for the air pump, feed-water heater pump, and stoker. It is carried forward and enters the exhaust pipe leading from the exhaust passage in the cylinder saddle to the feed heater. On the engines fitted with boosters, the exhaust from the booster cylinders enters the exhaust pipe on the right side and passes through the heater.

The Schmidt Super-pressure Locomotive.

Another German locomotive of the year which has created no little interest is the extra high-pressure engine built by Henschel and Sons, of Cassel. As

ment of a double boiler, one part of which operates in the usual way at 250 lb. pressure and the other part at 850 lb. The high-pressure boiler is a plain steel drum carried above the fire-box and steam is generated in it by the Perkins' method. Within the drum are placed several groups of pipes, which are in communication with tubes which form the fire-box walls

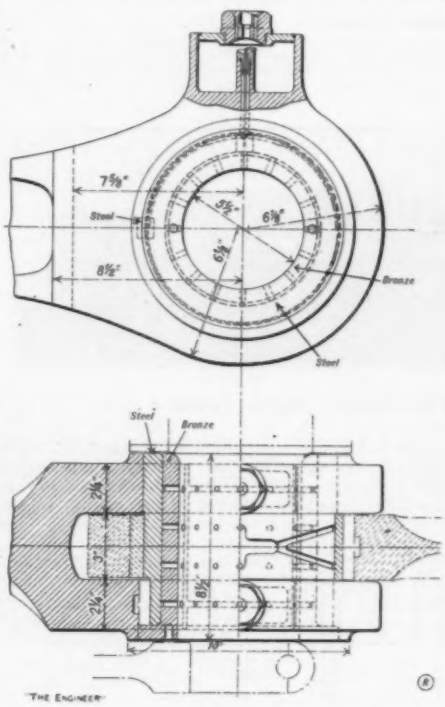


FIG. 6—WOODARD CONNECTING-ROD HEAD

and crown. This circuit is completely closed. The steam generated in the fire-box tubes is condensed in the tubes in the drum, giving up its heat to water, and is again evaporated in the tubes. The only fresh water that enters is a small amount needed for make-up. The steam is generated in the drum at between 850 lb. and 900 lb. per square inch and is delivered direct to

year was a kind one to the private locomotive builders of this country. A few good orders were placed, but on the whole it must be admitted that business was no better than in 1926. As far as foreign trade is concerned the position is serious, for, as shown by the recent failure of British firms to secure any part of a large South African order, our prices are too high compared with those of America and Germany. It is remarkable that America should be able to undersquote us for locomotives, when for nearly all other kinds of machinery her prices are higher than ours. There is, we are glad to say, no question whatever about the quality of the British product; indeed, the very high standard of excellence of British locomotives is acknowledged the world over. But there would appear to be something wanting in our methods of construction, for we ought certainly to be able to build locomotives as cheaply as America.

The Vulcan Foundry, Ltd.—The Vulcan Foundry, Ltd., of Newton-le-Willows, was engaged upon an order for fifty three-cylinder compounds for the L.M.S. Railway. These engines have the 4–4–0 wheel arrangement, one 19in. by 26in. H.P. and two 21in. by 26in. L.P. cylinders. The working pressure is 200 lb. and the total weight of engine and tender is 105 tons. They are being used with great success for fast passenger traffic and have 6ft. 9in. wheels. This is a standard type on the old Midland, but the cylinders were originally ¾in. bigger in diameter. Another interesting engine is the new Indian broad-gauge standard locomotive, of which the Vulcan Foundry, Ltd., has built twenty-eight. On page 16 we illustrate one of these handsome engines. The gauge is 5ft. 6in. and the total weight 155¼ tons. With two cylinders, 21½in. by 28in., driving 6ft. 2in. wheels, and with a mean pressure taken at 90 per cent. of the working pressure of 180 lb., they develop a tractive effort of 28,335 lb. The evaporative surface is 1840 square feet in area and the grate area is 45 square feet. Fifty-two more broad-gauge engines of various types and forty-seven new standard metre-gauge engines are also in hand for India. For the Assam-Bengal Railway, metre gauge, the same builders completed ten 2–8–2 engines with six-wheeled tenders, and for Tanganyika, also metre gauge, a couple of 2–6–2 tank engines.

Beyer, Peacock and Co., Ltd.—The three most interesting engines completed by Beyer, Peacock and Co., Ltd., of Gorton, Manchester, were two "Garratts" and a "Pacific" of metre gauge for the Federated Malay States Railways. The last-named is of a type already in use, but it has been entirely redesigned,

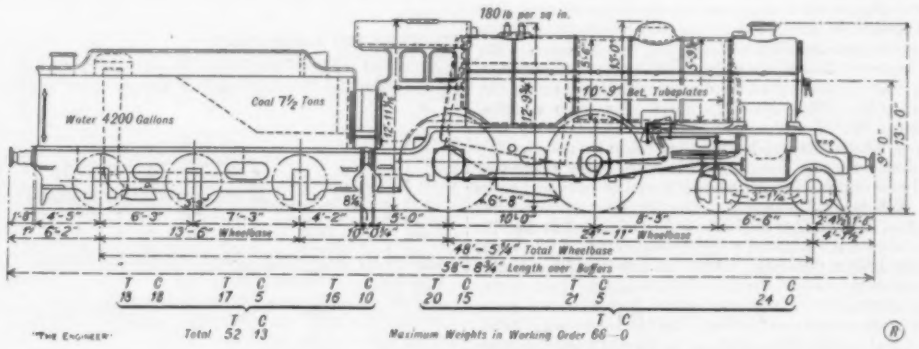


FIG. 7—L. AND N.E. RAILWAY—THREE-CYLINDER LOCOMOTIVE

a single high-pressure cylinder of 290 mm. diameter at that pressure. The exhaust is mingled with an appropriate amount of highly superheated steam at 250 lb. from the barrel of the boiler and enters two low-pressure cylinders, from which it exhausts in the usual way to atmosphere. The engine has undergone very careful tests and has shown a remarkably low coal consumption, as little as 2·31 lb. per draw-bar

with a view to improving the general weight distribution and to bring the whole into line with modern practice. The cylinders are 17in. by 24in., driving coupled wheels 4ft. 6in. in diameter, and the total weight in working order is 91½ tons. The two "Garratt" engines are more interesting, one for the Burma Railway being a compound, whilst the other has the largest driving wheels yet used in this type of

locomotive, as speeds up to 55 miles an hour have to to be maintained.

The Burma Railway Company already possesses one simple "Garratt" engine, but as it has included in its locomotive policy a number of compound engines, it was decided to have the new engine built as a compound with a view to seeing if it would show any improvement on the fine performances shown by the previous non-compound engine. The conditions under which the new engine will have to work are exceedingly severe, for continuous gradients of 1 in 25, associated with curves of 330ft. radius, for which no compensation is allowed, making the gradient equivalent to 1 in 21·4, have to be climbed.

The two high-pressure cylinders are arranged on the hind engine unit, and are 17½in. diameter by 20in. stroke, whilst the two low-pressure cylinders on the front engine unit have a diameter of 26½in. and a 20in. stroke.

As far as possible, the details of this engine are duplicate of those of the earlier engine, the boiler being the same, excepting that the pressure has been increased from 180 lb. to 200 lb. The other principal dimensions are as follows :—

Coupled wheels	3ft. 3in. diameter
Boiler, total heating surface	1735 sq. ft.
Superheater	319 sq. ft.
Grate area	43 sq. ft.
Weight in working order	103 tons 7 cwt.
Gauge of railway	1 m.

Two engines for the San Paulo Railway, of which we give an illustration on page 16, have been designed for handling the heavy express passenger trains of this railway, which run up to 440 tons in weight and have to be hauled over gradients of 1 in 40.

They are of the 2–6–2, 2–6–2 type, with simple-expansion cylinders using superheated steam. The principal dimensions are as follows :—

Cylinders	20in. by 26in.
Coupled wheels	5ft. 6in.
Rigid wheel base, each unit	12ft.
Total wheel base of engine	73ft.
Boiler, total heating surface	2954 sq. ft.
Superheater	716 sq. ft.
Grate area	49·2 sq. ft.
Working pressure	200 lb. per sq. in.
Total weight in working order	158·25 tons
Weight available for adhesion	111 tons
Gauge of railway	5ft. 3in.

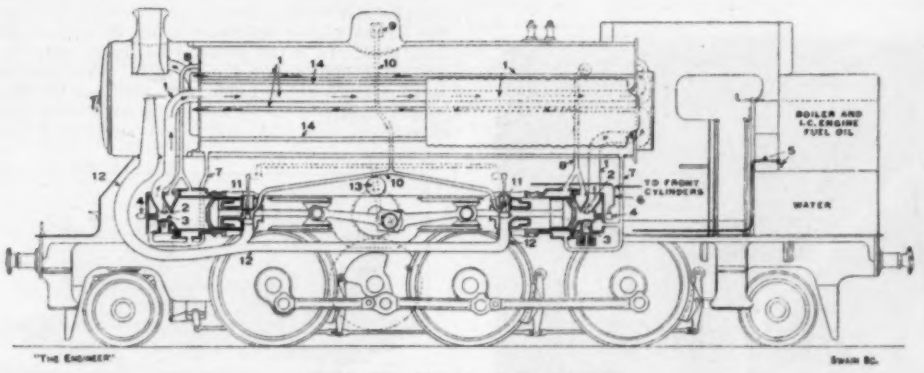


FIG. 8—THE KITSON-STILL SYSTEM

Description of Piece.—(1) Internal Combustion Exhaust Passage; (2) I.C. Exhaust Valve; (3) I.C. Air Inlet Valve; (4) I.C. Fuel Oil Valve; (5) I.C. Fuel Oil Pipe (Suction); (6) I.C. Fuel Oil Pipe (Delivery); (7) I.C. Cylinder and Head Cooling Water Inlet; (8) I.C. Cylinder and Head Cooling Water Outlet; (9) Steam Regulator; (10) Steam Inlet Pipe; (11) Steam Piston Valve; (12) Steam Exhaust Pipe; (13) Steam Valve Gear; (14) Fire-box Flue Tubes.

Nasmyth, Wilson and Co., Ltd.—Amongst the locomotives completed by Nasmyth, Wilson and Co., Ltd., of Patricroft, near Manchester, during the year are four handsome tank engines for the Nigerian Railways, which have a 3ft. 6in. gauge. One of these locomotives is illustrated by Fig. 10. It weighs in working order 71·8 tons, and has cylinders 18 by 22, driving 4ft. 6in. coupled wheels. The working pressure is 160 lb., and at 75 per cent. of it the tractive effort is 15,840 lb. The total heating surface is 1155 square feet, and the grate area 17·5 square feet. The side tanks carry 1500 gallons and the bunker tank 500 gallons of water and 3½ tons of coal. Another engine—Fig. 12—of exceptional interest, made by the firm is the 2ft. 6in. gauge locomotive, designed by Captain Keith Calthrop, for the Barsi Light Railway, of which he is now the C.M.E. The cylinders of this powerful little engine are 15½in. by 18in., and drive 2ft. 10in. wheels, giving a tractive effort of 15,262 lb. at 75 per cent. of the working pressure, which is 160 lb. It has an evaporative surface of 888 square feet, and is fitted with a superheater of 177 square feet. The grate area is 20·5 square feet, from which it will be seen that the engines are exceptionally powerful for so small a gauge. In working order the engine and tender weigh over 61 tons, but the greatest weight per axle does not exceed 6¾ tons.

FIG. 10—NIGERIAN RAILWAYS TANK LOCOMOTIVE—NASMYTH-WILSON

North British Locomotive Company, Ltd.—To us of this country the production of many engines of the "Royal Scot" class for the London, Midland and Scottish Railway was the most important work done during the year by the North British Locomotive Company; but, as a matter of fact, the firm turned out as well many engines for foreign countries, 2–6–2 tank engines for the Cordoba Central Railway of Argentina, big engines with 20in. by 24in. cylinders, weighing in working order well over 87 tons; shunting tank engines for the Egyptian State Railways; broad-gauge, 5ft. 6in., tank engines, weighing nearly 92½ tons, for the Indian State Railways; and tank engines for the metre gauge Antofagasta Railways, with a 2–8–2 wheel arrangement, weighing 90 tons 12 cwt.; tender engines for the Sudan Government Railways, 3ft. 6in. gauge; and for Mashonaland Railways, of the same gauge.

Peckett and Sons, Ltd.—Amongst locomotives of the smaller kind, we may mention two turned out by Peckett and Sons, Ltd., of Bristol, during the year. They are both saddle tank engines, and one was supplied to a gasworks in the Home Counties and the other—one of five—to a well-known cement company in Kent. The gauge of both railways is 4ft. 8½in. The first engine has 9in. by 14in. cylinders and 2ft. 3in. four-coupled wheels, and weighs loaded 14 tons 15 cwt., whilst the other, a much bigger engine—which we illustrate—Fig. 14—has 14 by 22 cylinders and 3ft. 2½in. wheels. It weighs in working order 28 tons.

Robert Stephenson and Co., Ltd.—We illustrate—Fig. 13—a fine engine built by Robert Stephenson and Co., Ltd., of Darlington. It is one out of an order for six

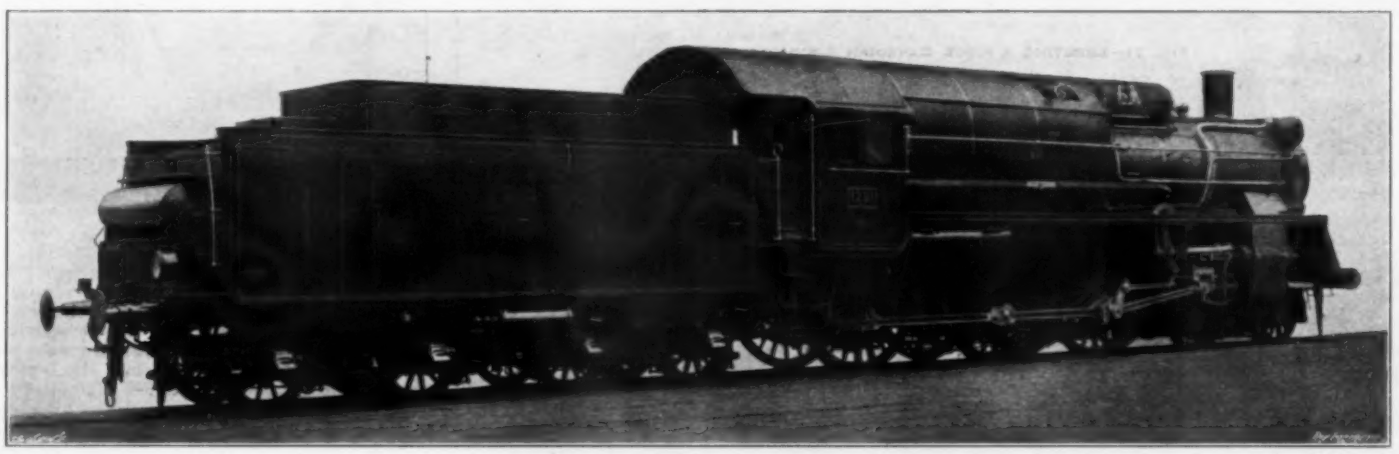


FIG. 9—SCHMIDT SUPER-PRESSURE LOCOMOTIVE—HENSCHEL

placed by the Kenya-Uganda Railway, which is metre-gauge; all the engines are fitted for oil firing. They have cylinders 21½ by 28, driving wheels 4ft. 3in. in diameter. The total heating surface is 2310 and the superheater has 574 square feet of surface. The grate area is 40·5 square feet. A tractive effort of 37,938 lb. is secured with 85 per cent. of the boiler pressure, which is 180 lb. The tender carries 5000 gallons of water and 3000 gallons of fuel oil. The total weight in running order is nearly 156 tons. An order for sixteen metre-gauge 4–6–0 tender engines for the South Indian Railway was shipped whole in one consignment from Middlesbrough. Two heavy "Mikados" for the Sudan Government Railways, with 21 by 27 cylinders, were practically completed by the end of the year, and, amongst other engines, ten cross-compounds, 2–8–2, with 21in. and 31½in. by 26in. cylinders, were in hand for the Central Argentine Railway.

The Hunslet Engine Company, Ltd.—We are told by the Hunslet Engine Company, Ltd., of Leeds, that despite delays caused by the aftermath of the coal strike, it turned out over forty locomotives of varying types, both tender and tank, during the year. Eighteen of these engines went to the L.M.S.; nine to the Ceylon Government Railways; and four to the Sudan Government Railways. The remainder was composed of industrial locomotives for foreign countries.

Sir W. G. Armstrong, Whitworth and Co., Ltd.—The principal orders completed by Sir W. G. Armstrong, Whitworth and Co., Ltd., at Scotswood, were twenty-five engines for the 3ft. 6in. railways of the Queensland Government, and ten cross-compound locomotives for the 5ft. 6in. Argentine Railways. The Queensland engines have two cylinders, 17 by 22, driving 3ft. 9in. wheels, and the Argentine engines have one 22½ by 26 and one 31½ by 26 cylinders, with driving wheels 5ft. 2in. in diameter. The firm

has in hand thirty 4–8–0 three-cylinder oil-burning locomotives for the Buenos Aires Great Southern Railway, and twenty 2–6–0 engines for the Egyptian State Railways, besides a large number of boilers.

William Beardmore and Co., Ltd.—The principal locomotive work done by William Beardmore and Co., Ltd., consisted in the completion of an order for twenty 0–6–2 standard tank engines for the London and North-Eastern Railway, and the commencement of work upon an order for twenty-five 0–6–0 goods tank engines for Class 7100 of the London, Midland and Scottish Railway.

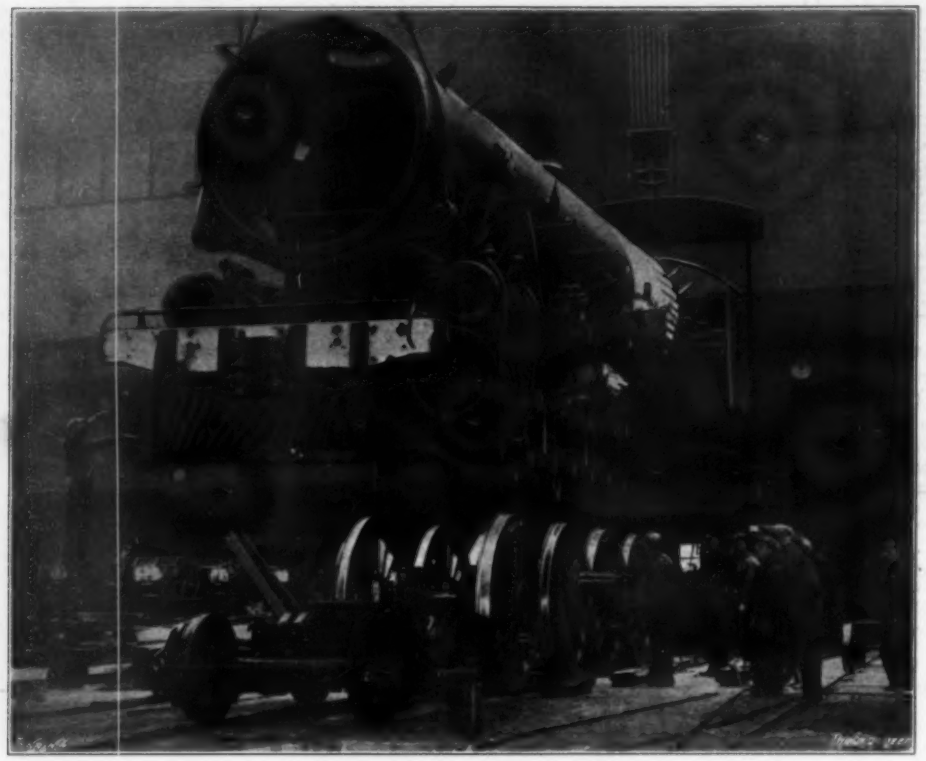


FIG. 11—ERECTING A HUGE CANADIAN LOCOMOTIVE

W. G. Bagnall, Ltd.—Quite a number of small locomotives for overseas were made by W. G. Bagnall, Ltd., of Stafford, during the year. The largest of them had cylinders 15½ by 22, and were ordered by the Assam Railways and Trading Company. They are not yet complete. For the Umfolozi Sugar Plantation the neat little side tank engine—which we illustrate, Fig. 15—was delivered. The gauge of the railway is 2ft. 6in.; the cylinders are 12in. by 18in.; and the driving wheels 2ft. 9½in. The tanks hold 750 gallons of water and the tender carries 1 ton of coal. The grate area is 11½ square feet and the tractive effort 10,600 lb. with a mean effective pressure at 85 per cent. of the boiler pressure of 160 lb. The engine weighs in running order 28 tons.

FIG. 12—BARSI LIGHT RAILWAY 2FT. 6IN. GAUGE LOCOMOTIVE—NASMYTH-WILSON

Small Internal Combustion Locomotives.

The use of oil engines for driving small locomotives makes steady progress, and several firms now turn out very serviceable engines. John Fowler and Co. (Leeds), Ltd., have designed a motor shunting engine which is doing good work, and will be described at an early date in these columns; whilst Robert Hudson, Ltd., of Leeds, has developed a rail tractor driven by a 20 B.H.P. engine running on paraffin or petrol. It is carried on four wheels and fitted with a "Fordson Tractor" unit. On the level it will start a train of 85 tons in low and 40 tons in high gear, and in the respective gears it will haul trains of 12 tons and 4 tons up a gradient of 1 in 20.

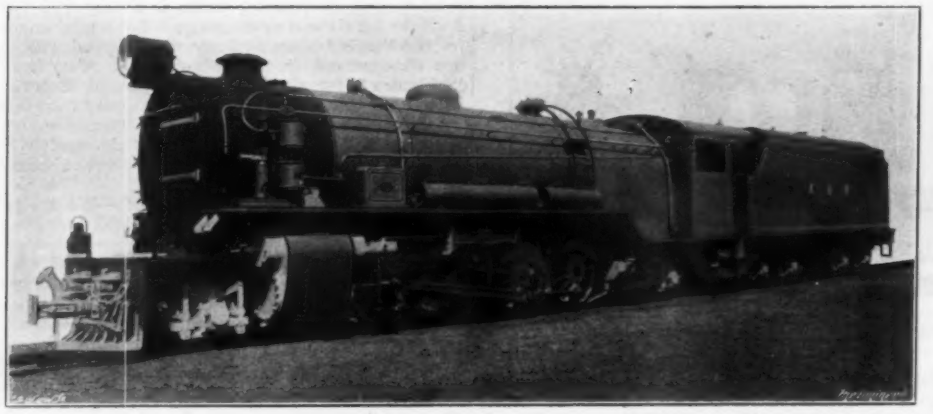


FIG. 13—KENYA-UGANDA RAILWAY—METRE-GAUGE LOCOMOTIVE—STEPHENSON

A Turbine Locomotive.

During the year the I. A. Maffei A.G., of Münich, completed a turbine locomotive which is not unlike the Krupp engine described in our issue of January 2nd, 1925. In it the pressure has been taken up to well over 300 lb. per square inch. The maximum horse-power is about 2500. It differs from the Krupp engine mainly in the condenser, in which thin copper sheets are used. A still more interesting turbo-locomotive is in hand, for it is to be fitted with a Benson boiler, which will generate steam at over 3200 lb. pressure. This pressure will be reduced for use in a high and low-pressure turbine. The engine is designed to develop 2500 H.P. on about 1·1 lb. of coal per B.H.P. hour.

FIG. 14—TANK ENGINE—PECKETT

Narrow-gauge Three-cylinder Engines.

It is of interest to note how the use of three cylinders is spreading. We have just heard that Mr. P. C. Dewhurst, of the Colombia Railways, South America,

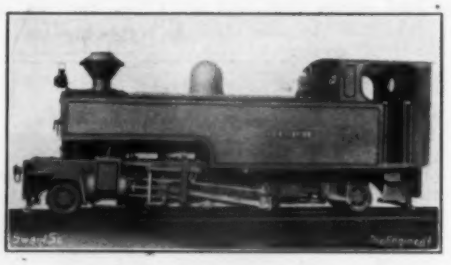


FIG. 15—TANK ENGINE—BAGNALL

received during the year two 4–6–2 three-cylinder locomotives for the 3ft. gauge Pacific Railway, one made in Germany and the other in Belgium. They are believed to be the first three-cylinder engines for so small a gauge, and are only made possible by the outside framing which Mr. Dewhurst specifies for all 3ft. and metre-gauge engines. In one of these engines the inside valve is driven by a return link, and in the other by the Gresley gear, but with the floating levers placed behind the cylinders, as in the new 4–4–0 L. and N.E.R. engines described and illustrated above.

BRITISH COAL IN BELGIUM.

OF the 590,000 tons of coal required for the Belgian National Railways during the first quarter of 1928, 80,000 tons will be bought in England, 5000 tons in Germany, 5000 tons will come from the Saar district, and the remaining 500,000 tons from Belgian collieries. The following table shows the allocation of the contracts for the 90,000 tons bought abroad :—

Quality.	Tons purchased.	From.	Tons offered.	Range of prices quoted, per ton.
				s. d. s. d.
Screened bituminous	30,000	Britain	740,000	15/– to 19/8·
Run of mine bituminous	40,000	Britain	1,305,000	13/5 to 19/8
Small bituminous	10,000	Britain	140,000	10/10 to 15/11
Small "demi-gras"	5,000	The Saar	50,000	11/11 to 14/9
Fines, 8 to 10 mm.	5,000	Germany	90,000	11/9 to 16/11

It will be observed that 2,325,000 tons of coal were offered from foreign sources for the 90,000 tons actually demanded. The prices at which the various contracts have been placed have not yet been made public, but it is stated that the new contracts for Belgian coal show an average reduction of 10d. per ton on the last contracts, while the foreign coal has been purchased about 16·5d. per ton cheaper than on the last occasion. The adjudication of the contracts for the foreign coal indicates that British coal is regaining its old place in the continental markets. It will be recollected that when the last quarterly contracts were placed by the Belgian National Railways the whole of the coal purchased abroad was obtained from Germany.

A WORSTED mill is to be organised in Victoria, British Columbia, at a cost of 250,000 dollars.

Steamships and Steam Marine Engineering in 1927.

IN marked contrast with the shipbuilding depression of 1926, last year will stand out as a period of steady recovery. Great Britain and Northern Ireland again maintained with ease the leading place among the shipbuilding countries of the world. There was a notable improvement in the Clyde output, which has now returned to a pre-war average, and which gave to Scotland the premier position among the various centres of shipbuilding. The Tyne was second, and to Swan, Hunter and Wigham Richardson, Ltd., falls the honour of the largest output, totalling over 137,000 tons, in which figure, however, were included about 50,000 tons for the Singapore floating dry dock. Harland and Wolff, Ltd., had a total output for all yards of close upon 95,000 tons. There was a noticeable improvement in the returns for the Wear and Tees, which are third and fourth in order of output, with Belfast in the fifth position. The output on the Mersey was also a good one.

The very satisfactory results obtained were due in the first instance to a welcome increase in orders; but other equally important factors were well-equipped shipyards, and, above all, the comparative freedom from labour troubles which was enjoyed. Such freedom was the direct result of very close co-operation between the shipbuilding employers and the trade unions, both nationally and in the various workshops and shipbuilding centres. Agreements with regard to conciliation machinery for the adjustment of wage differences were concluded during last year with all the trade unions in the industry with the exception of the Boilermakers' Society. It is hoped that that body of workers will shortly fall into line on this most important industrial matter. The suggestion made by the Shipbuilding Employers' Federation that a joint effort should be made to formulate some scheme whereby an index could be fixed by which the prosperity of the industry might be measured and wage differences be automatically arranged has not yet been accepted or taken up by the unions. There is, however, still every hope that a mutual and helpful understanding will be continued, and the continued success of the industry be thereby further ensured.

Technical advances in the period under review were chiefly in the direction of the utilisation of higher steam pressures and temperatures and improvements in the performance of turbines and reciprocating engines. Attention was also paid to the design of new types of marine boilers, the production of more efficient condensers, and the economical operation of engine-room auxiliaries.

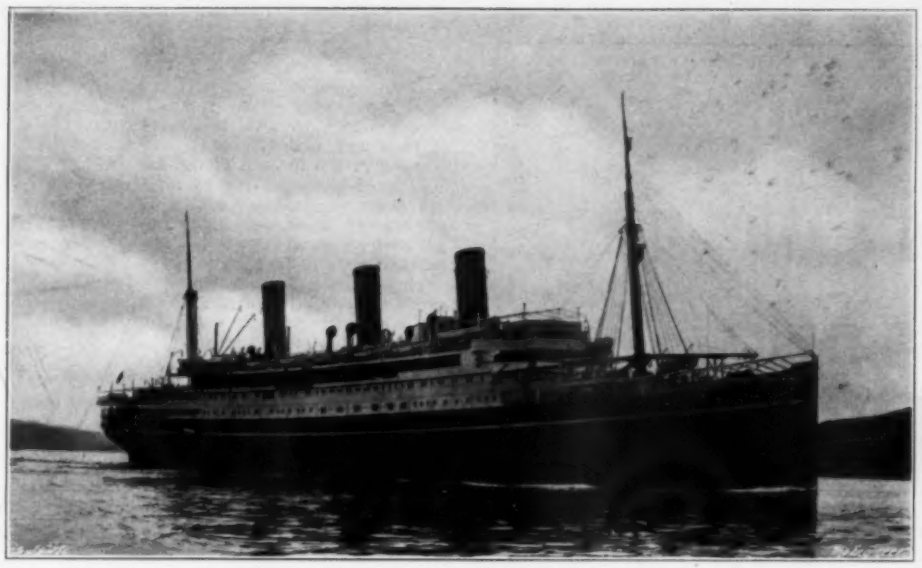


FIG. 1—THE RE-ENGINED CANADIAN PACIFIC LINER EMPRESS OF AUSTRALIA

Some Notable Liners and Ships.

The first launch to be made in 1927 was that of the Arandora, the third geared turbine passenger and cargo liner to be built at Birkenhead by Cammell Laird and Co., Ltd., for the South American service of the Blue Star Line. The first half of the year saw the completion of this fine fleet of refrigerated meat-carrying steamers with their exceptionally commodious and artistically arranged passenger accommodation. The first of the vessels, the Almeda, was described and illustrated in our last issue of 1926 and in THE ENGINEER for April 8th, 1927, a comprehensive account of the special refrigerating equipment was given. The refrigerating machinery is the largest of its kind constructed for marine work, and the insulation was carried out on the "panel" system to the designs of Mr. E. A. Thomson, the company's senior superintendent engineer. Early in May last John Brown and Co., Ltd., of Clydebank, completed the Avelona, and shortly before that date the Avila was finished at the same yard.

A liner, see Fig. 1, which, although not new, is nevertheless a ship of outstanding interest from a marine engineering point of view, is the Empress of Australia, belonging to Canadian Steamships, Ltd. This liner was entirely re-enginedby the Fairfield Shipbuilding and Engineering Company, Ltd., under the supervision of Mr. John Johnson, the owners' chief superintendent engineer. She ran her trials in June last and has since made several Atlantic voyages and cruises, during which her machinery performance has earned for her the reputation of being the most economical oil-fired liner afloat. The German turbines and boilers, along with the Föttinger transmission gear, were removed and a 20,000 S.H.P. arrangement of Parsons type turbines was installed, with new oil-fired Scotch boilers designed for a working pressure of 220 lb. per square inch with 220 deg. of superheat. The overall efficiency of the turbines was increased by using Weir regenerative condensers and electrically operated pumps and auxiliaries, which were supplied with current from oil-electric generator plant. The trial fuel consumption of 0·69 lb. of oil per S.H.P. hour was improved upon in service, and on her last trip across the Atlantic before starting upon her world tour the Empress of Australia made an average speed of 19·6 knots on a fuel consumption for all propelling purposes of 0·66 lb. of oil per S.H.P. per hour and about 0·7 lb. for all purposes throughout the ship. The fuel consumption per day for all purposes was 155 tons.

We pass from this notable liner to the extensive programme of construction which was undertaken last year by the Canadian Pacific Railway, Co. At the end of November no less than seven Canadian Pacific vessels, aggregating over 72,000 gross tons, had been launched, constituting a world's record, we believe, in any one shipbuilding programme. In that total there was included one of four 20,000-ton liners of the "Duchess" class, the first of which, the Duchess of Atholl, was launched at Dalmuir by William Beardmore and Co., Ltd., on November 23rd. There were also five large cargo vessels of the "Beaver" class now being constructed by Denny's, Barclay, Curle's, and Armstrong-Whitworth's; in addition to these there was a Pacific ferry steamer, the Princess Elaine, a well-appointed ship of 2150 gross tons propelled by 5350 S.H.P. steam turbines. The last-named vessel was built at John Brown's yard, Clydebank, where three other Canadian Pacific liners of the "Duchess" class are being constructed. These are 600ft. vessels of 20,000 tons gross with high-pressure Parsons type geared turbine machinery. The boiler arrangement is of interest, as a combined installation of Yarrow water-tube and Scotch boilers will be fitted, which will allow the water-tube boilers to be fed with pure condensate.

Additional interest attaches to the machinery arrangement of the "Beaver" class cargo vessels, because certain of these ships are being fitted with Yarrow boilers and mechanical stokers of the latest Erith-Roe pattern supplied by Erith's Engineering Company, Ltd. The first ship of this type to be completed was the Beaverburn, built by William Denny and Bros., Ltd., of Dumbarton, which we illustrate in to-day's special Supplement. We shall deal fully with this ship in a later issue, but brief reference may be made to the boiler arrangement of this and the two sister ships, the Beaverdale and Beaverford, which were launched by Barclay, Curle and Co., Ltd. In each vessel Parsons single reduction geared turbine machinery is installed, and there are four Yarrow boilers and two single-ended Scotch boilers. The working steam pressure is 250 lb. per square inch, and superheaters are fitted on all water-tube and one Scotch boiler capable of giving a superheat of 250 deg. Fah. Provision is also made in one Yarrow boiler to provide saturated steam for port use by means of a

FIG. 2—YARROW BOILER WITH ERITH-ROE STOKER

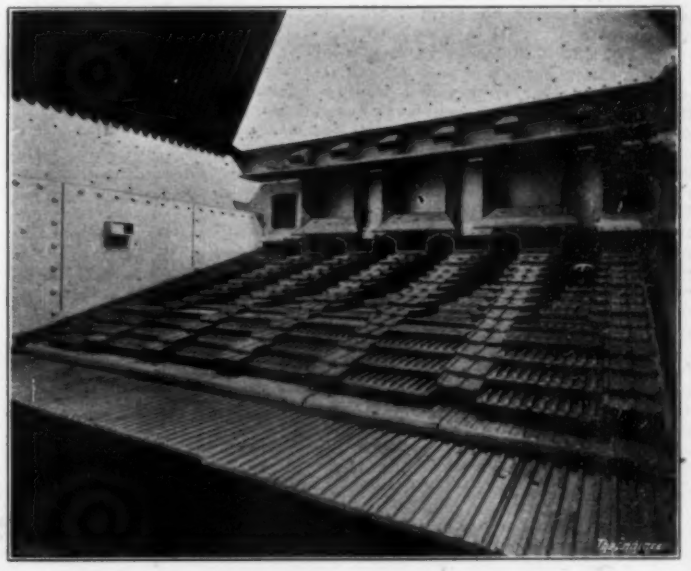


FIG. 3—YARROW BOILER COMBUSTION CHAMBER

de-superheating arrangement. As shown in Fig. 2, the Yarrow boilers are fitted with mechanical stokers. The illustration reproduced shows one of the boilers for the Beaverbrae, which was photographed when assembled in Messrs. Yarrow's boiler shop. Fig. 3 is a view showing the inside of the combustion chamber. The Scotch boilers are arranged for hand firing. Towards the end of the year the Beaverburn completed successful trials on the Clyde and was handed over to her owners.

Another important ship of the year, which is also illustrated in to-day's Supplement, was the White Star liner Laurentic, which is the second vessel to bear that name. She was built by Harland and Wolff. Ltd., at Belfast, and has a length of 600ft. with a gross tonnage of 18,700 and a sea speed of about 16½ knots.

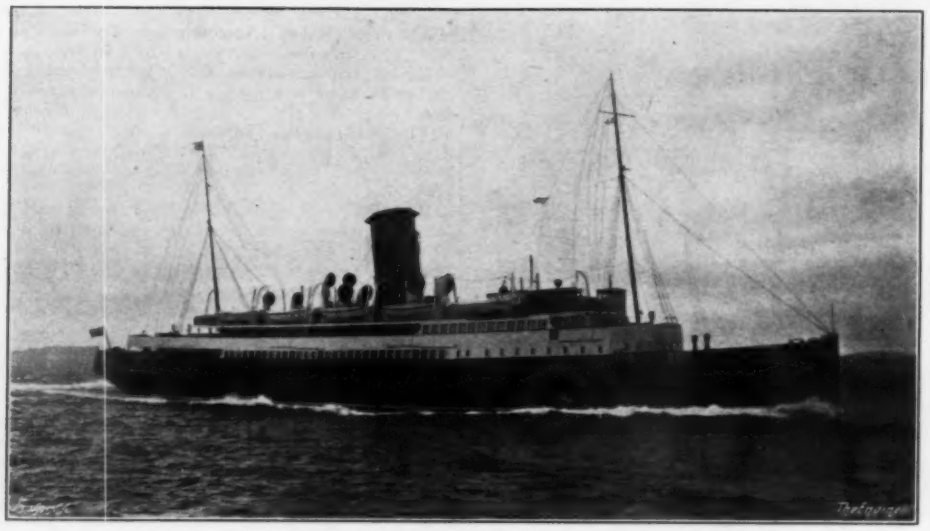


FIG. 4—THE ISLE OF MAN STEAMER BEN-MY-CHREE

The machinery comprises a three-shaft arrangement of combined reciprocating engines and steam turbines. Each of the wing shafts is coupled direct to a four-cylinder triple-expansion reciprocating engine, which exhausts to a low-pressure turbine arranged on the centre shaft. The turbine exhausts in turn into two condensers of the Weir regenerative type. Superheated steam is supplied by four double-ended and four single-ended boilers burning coal under natural draught. The Laurentic is designed to carry 1600 passengers and will be one of the largest liners on the St. Lawrence route.

At the Barrow-in-Furness yard of Vickers Ltd. the twin-screw passenger liner Orford for the Australian services of the Orient Steam Navigation Company, Ltd., was launched and fitting out begun. She will be ready for trial in March next. The Orford is a 630ft. ship of 20,000 gross tons, and is propelled by twin-screw Parsons type single-reduction geared turbines. Another ship which was completed at Barrow was the Kedah, a twin-screw vessel ordered by Alfred Holt and Co., for the Singapore Penang service of the Straits Steamship Company, Ltd. Her hull was built of a special high elastic limit steel, which was developed by Mr. F. Grimshaw Martin, of Alfred Holt and Co. Extra strength is thus given, and the steel is also more capable, we understand, of resisting corrosion. The turbines are of the Parsons geared type, designed for 200 lb. steam pressure, with a superheat of 150 deg. Fah. The normal designed output at sea is 5800 S.H.P. with a 6200 S.H.P. maximum.

In connection with geared turbines it was of interest to learn that at the close of 1927 the Parsons Marine Steam Turbine Company, Ltd., had constructed turbines and gearing corresponding to an output of 65,500 S.H.P., while gearing cut for licencees and other engineers amounted to 79,200 horse-power. The Clyde high-pressure steamer King George ran daily throughout the summer season, and showed an economy in coal consumption of 30 per cent. compared with similar vessels on the same service. Her fine performance was marred by a mishap, which took place when she was being brought into harbour, before laying up for the winter, when, owing to the bursting of a boiler tube two deaths by scalding took place. The cause of the accident has been the subject of a Board of Trade inquiry, and it is expected that the official report of the investigation will shortly be available.

Irish Channel Steamers and Mersey Ferry Boats.

One of the notable channel steamers of the year is the Isle of Man Steam Packet Company's new Ben-My-Chree, which was built by Cammell Laird and Co., Ltd., and is shown in Fig. 4. She is a 22-knot ship, with a length of 355ft., and is propelled by twin-screw Parsons single reduction-geared turbine machinery. Each set of turbines comprises one high-pressure turbine and one low-pressure turbine, which are connected through flexible couplings to pinions driving a large gear wheel on the propeller shaft. Both high and low-pressure astern turbines are provided in the ahead turbine casings. The condensers are of the Weir regenerative type. An interesting point about the new Ben-My-Chree is that she was built in a period of less than seven months from the time that the keel was laid.

Towards the end of November there was launched from the Dumbarton Yard of William Denny and Bros., Ltd., the first of three cross-Channel boats which that firm is constructing to the order of the London, Midland and Scottish Railway Company for the Heysham–Belfast service. It will be recalled that during the year the steamer services for Belfast were concentrated at Heysham, and were withdrawn from Fleetwood, which will be developed as a fishing centre. The first steamer is named the Duke of Lancaster, and she has a length of 350ft., with a breadth of 53ft. and a depth moulded of 19ft. to the main deck. She is designed for a speed of about 21 knots, and her propelling machinery comprises a twin-screw arrangement of Parsons' type single reduction-geared turbines, of about 8000 S.H.P. Steam will be raised in six coal-fired Babcock and Wilcox water-tube boilers, which work on the enclosed grate system, and are designed for a working pressure of 225 lb. per square inch. The new ships are equipped with over 150 single berth cabins as well as suites and state rooms, and about 500 tons of cargo can be carried.

Two other smaller vessels which are operating in the Mersey channel on the ferry service between Liverpool and Secombe are of interest, because they are the first British ships to be equipped with hand controlled Flettner rudders. They were built by the Caledon Shipbuilding and Engineering Company, Ltd., of Dundee, and the rudder equipment was supplied by Harfield and Co., of Blaydon-on-Tyne. A description of ferry boats Wallasey and Marlowe will be found in THE ENGINEER of September 23rd.

New Types of Self-discharging Colliers.

Among the 1927 steamships constructed for special purposes may be singled out for mention two self-discharging colliers, which were built for service on the Great Lakes and canals of Canada and North America. One of these ships, the Coalfax, is illustrated in Fig. 5. It was constructed by the Furness Shipbuilding and Engineering Company, Ltd., of Haverton Hill-on-Tees, for Canadian lake and canal service. The hull dimensions are 258ft. in length, 43ft. 2in. breadth and 25ft. in depth, the deadweight carrying capacity being about 2400 tons at 14ft. draught in fresh water and 3050 tons on 16ft. 1½in. when clear of the canals. As is usual in such vessels, the propelling machinery is placed aft, and it comprises a set of triple-expansion engines by the Shields Engineering and Dry Docks Company, for which steam is supplied by two multitubular marine boilers. The boilers have a diameter of 12ft. 6in. and a length of 10ft. 6in., and are designed for 180 lb. working pressure. The main interest in the ship, however, attaches to the coal-unloading equipment, part of which is to be seen in our illustration, which shows the central tower and the unloading boom conveyor shipped in mid-deck position. The plant was designed and supplied by Fraser and Chalmers Engineering Works, of Erith, Kent, in conjunction with its associated firm, the Robins Conveying Belt Company, of New York. The coal in the ship is accommodated in two lines of hoppers, of which there are twenty on each side of the ship. Each hopper is fitted with a slide door, uncovered by means of rack and pinion, gear giving a 30in. by 24in. opening in the bottom of the hopper. The coal is discharged through this opening on to two 30in. belt conveyors that are spaced at 16ft. centres, and which run beneath the hoppers the length of the ship. At the driving end the two belts referred to are raised 5ft. and they deliver on to two short inclined belt conveyors each 36in. wide, with a length of 35ft., and with a total lift of 13ft. 6in. The belts are each set at an angle towards a 48in. elevator, which lifts the coal into a swivel receiving chute. The coal from the elevator is then delivered on to a 36in. boom with a belt conveyor, having a length over the extreme centres of 96ft. By means of wire ropes the boom can be elevated or slewed from a control tower, the extreme height at which the coal can be discharged being about 50ft. above the bottom of the ship and 75ft. clear of the ship's side. The two hold conveyors and the inclined conveyors each have a designed capacity of 175 tons per hour, while the elevator and the boom conveyor are both designed to deal with double that quantity of coal.

A ship of a somewhat similar type is the Valley Camp, which was completed by Swan, Hunter and Wigham Richardson, Ltd., for the Valley Camp Coal Company, Ltd., for service on the Great Lakes of America. Her length is 260ft., with a beam of 43ft., and a deadweight carrying capacity of 2000 tons on a draught of a little over 14ft. The self unloading gear was supplied by Mr. Leatham D. Smith, of Sturgeon Bay, Wisconsin, and it was fitted on board by the builders. It was designed for outputs up to 600 tons per hour. It essentially comprises two scrapers working in two tunnels, extending the full length of the holds and loading on to 48in. belt conveyor, with an overside conveyor capable of discharging 62ft. from the side of the ship, and at a maximum elevation of 30ft. above the deck.

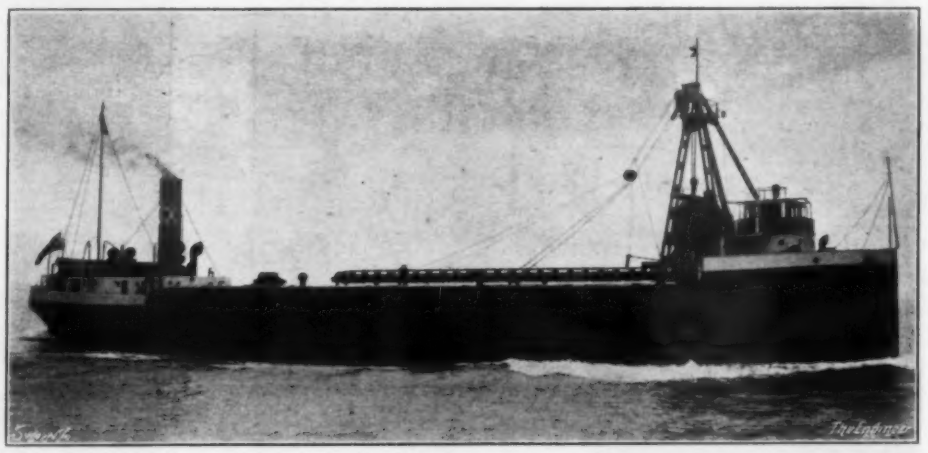


FIG. 5—THE SELF-DISCHARGING COLLIER COALFAX

Marine Boiler Practice in 1927.

The year 1927 saw a much wider application of the water-tube type of boiler for mercantile marine use. Babcock and Wilcox, Ltd., built at Renfrew, no less than seventeen water-tube boilers for Dutch owners, some of which were fitted with mechanical stokers. A further twenty-two boilers were, at the close of the year, under construction for British and foreign owners, and ships so fitted will include two Canadian-Pacific cargo vessels and the three L.M.S. Irish Channel boats already referred to in an earlier paragraph. Messrs. Babcock and Wilcox also constructed boilers for the Holland-America liner Statendam, which will work at a pressure round about 400 lb. per square inch, with a high degree of superheat.

Reference has been made to some of the boilers built by Yarrow and Co., Ltd., for the new cargo steamers for Canadian-Pacific Steamships, Ltd. These, as already noted, are 250 lb. boilers, with air heaters and superheaters. The boilers for the "Duchess" class

of Canadian-Pacific passenger liners, which will be built at Brown's and Beardmore's to Yarrow's designs, will, on the other hand, be designed for 350 lb., with a high degree of superheat. Yarrow and Co., Ltd., also have on order six high-pressure boilers for 400 lb. for the new P. and O. liner, which is to be built by Alexander Stephen and Sons, Ltd. During the year Yarrows have supplied a number of boilers for both power station and industrial uses for pressures up to 600 lb. per square inch, and steam temperatures up to 760 deg. Fah.

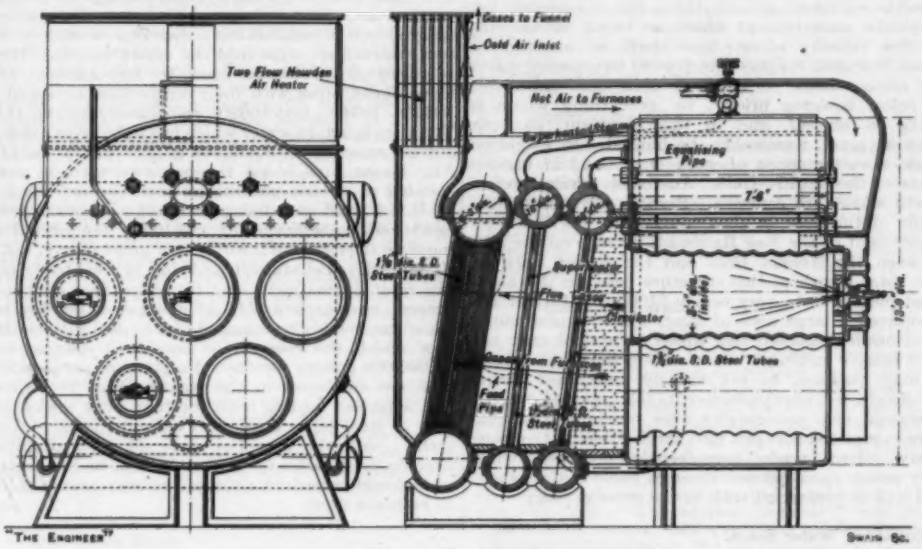


FIG. 6—315 LB. PRESSURE HOWDEN MARINE BOILER

In Fig. 6 we illustrate a new type of high-pressure boiler, which, in design, is intermediate between a water-tube boiler and a Scotch marine boiler, and is claimed to retain the best points of both types. It has been designed and is patented by James Howden and Co., Ltd., of Glasgow. The boiler we illustrate is intended for a working pressure of 315 lb. per square inch. It has a total heating surface of 3500 square feet, with an approximate evaporation of 20,000 lb. per hour. Including the water in the boiler, its total weight would be 68 tons. It will be seen that the Howden boiler comprises a short Scotch boiler with straight-through furnaces, at the back of which the circulator, superheater, and water tubes are arranged. When no superheating is required, the boiler can be shortened or, alternatively, economiser tubes can be fitted. The advantages claimed for the new boiler are that there is a large amount of water in circulation with ample steam space, and little tendency to priming. A reduced diameter and thinner shell can be employed, and there are no flat surfaces other than the ends which have to be stayed. As there is a difference of 700 deg. to 800 deg. Fah. between the temperature on the forward end of the cylindrical furnace and the water tubes, it is claimed that the tubes are not subjected to the intense heat of the fire, and both the tubes and the brickwork will therefore have a longer life. The weights of the boiler are considerably less than those of a cylindrical boiler, and the parts are convenient for installation aboard ship. Tests with a similar boiler installed at the maker's works showed efficiencies up to 87 per cent. We understand that the new design is suitable for use with mechanical stokers, or it may be employed with pulverised fuel.

Reciprocating Engine Improvements.

An interesting feature of the year's progress was the very determined and successful attempt of marine engineers to improve the performance of the reciprocating steam engine. In December trials took place of the Ellerman liner City of Canberra, which is propelled by quadruple-expansion engines built by the Central Marine Engine Works, West Hartlepool. The steam is supplied by four boilers arranged for either coal or oil burning and working under forced draught, and is superheated to about 560 deg. Fah., the working pressure being 265 lb. per square inch. Air heaters are fitted which deliver the air to the furnaces at 300 deg. Fah. The results of this installation will be awaited with interest, more especially as comparative performances will, in a few months' time, be obtained with similar ships fitted with geared turbines and oil engines. The sister geared turbine ship is the City of Roubaix, recently launched by Swan, Hunter and Wigham Richardson, while Barclay, Curle and Co., Ltd., of Glasgow, are constructing the motor vessel the City of Lille.

We show in Fig. 7 a new design of double compound engine with Lentz valve gear, which has been constructed by John Dickinson and Sons, Ltd., of Sunderland, for the steamer Holystone. The two high-pressure cylinders are 20½in. diameter and the two low-pressure cylinders 43½in. diameter with a stroke of 43½in. Both the inlet and the exhaust valves are of the Lentz poppet type. At a designed speed of 70 r.p.m. the engine is rated at 1700 horse-power. Steam will be supplied from two boilers working under natural draught at a pressure of 220 lb. per square inch and a total steam temperature of 620 deg. Fah. The trials of the Holystone took place about the end of the year.

At the Coatbridge Works of William Beardmore and Co., Ltd., a reciprocating marine engine fitted with Beardmore Caprotti valve gear was designed and built, and trials are to take place in a few weeks' time, after the engine has been installed in a ship. From the preliminary performances of this engine it is gathered that a considerable saving in steam may be obtained by using valve gear of this type.

Our review of the progress made in this line of development would not be complete without mention of the interesting design of oblique marine uniflow engine which Sulzer Bros. constructed during the year for a steamer on Lake Geneva. A full account of this engine was given in THE ENGINEER of June 24th last.

Recently Mr. S. G. Visker, the chief superintendent engineer of the Netherlands Steamship Company, read before the North-East Coast Institution of Engineers and Shipbuilders an interesting paper on the 500 lb. pressure reciprocating steam engines with hydraulically-operated valve gear which are fitted to the steamer Borneo. In the same paper a Hawthorn-Armstrong water-tube boiler, in which the tubes are arranged in X form is also described. In the issue of THE ENGINEER of December 16th we gave a summary of Dr. Gustav Bauer's paper read before the Institution of Engineers and Shipbuilders in Scotland, in which the results of some recent installations of combined reciprocating engines and exhaust turbines were given and various designs described. The paper is of special interest to British engineers, as this type of machinery is to be constructed by William Beardmore and Co., Ltd.

Improved Marine Condensers.

In describing more than one ship built during the year we have referred to the Weir type of regenerative condenser. A view of one of these condensers will be found in THE ENGINEER for June 17th, when the machinery of the Empress of Australia was described, while a full account of the regenerative principle as applied to power stator work was given in our issue of November 5th, 1926. The regenerative condenser is usually boat shaped and is furnished with two nests of tubes, an upper one, which is cooled by the second pass of water, and a lower group, through which the cooling water first passes. The tubes are so arranged that the entering steam penetrates to the bottom of the condenser through a clear passage. In so doing it reheats the condensate which rains down from the tube nests in the upper part of the condenser shell. The last portion of the steam flow takes place in an ascending direction, and tube surface is provided which acts as an air cooling medium, and is so arranged that it is self adjusting. In practice it is found possible to maintain a very small temperature difference between the entering steam and the condensate, and with a suitable air pump a vacuum of over 29in. is, it is said, quite easily maintained.

Another special condenser which has come to the fore in the period under review is the Delas-Ginabat condenser, which has been successfully employed in the French Navy and was installed on the liner Ile de France, illustrated in to-day's Supplement. In Great Britain this condenser is manufactured by the Mirrlees Watson Company, Ltd., of Glasgow. Its special features are two in number. The first is one relating to the pitching of the tubes, and was invented by Engineer Admiral Ginabat, of the French Navy. The tubes are arranged in a descending series with the centre line of every lower tube coinciding with the inner edge of the tube immediately above. This being so, water of condensation falling from any one tube strikes the surface of the tube below at its horizontal diametral edge, and dripping off again from the bottom of the tube only flows over one-quarter of the tube surface, leaving the other three-quarters dry as far as falling water is concerned. The second improvement, which is based on an invention by Monsieur Delas, relates to the grouping of the tubes, which are arranged in

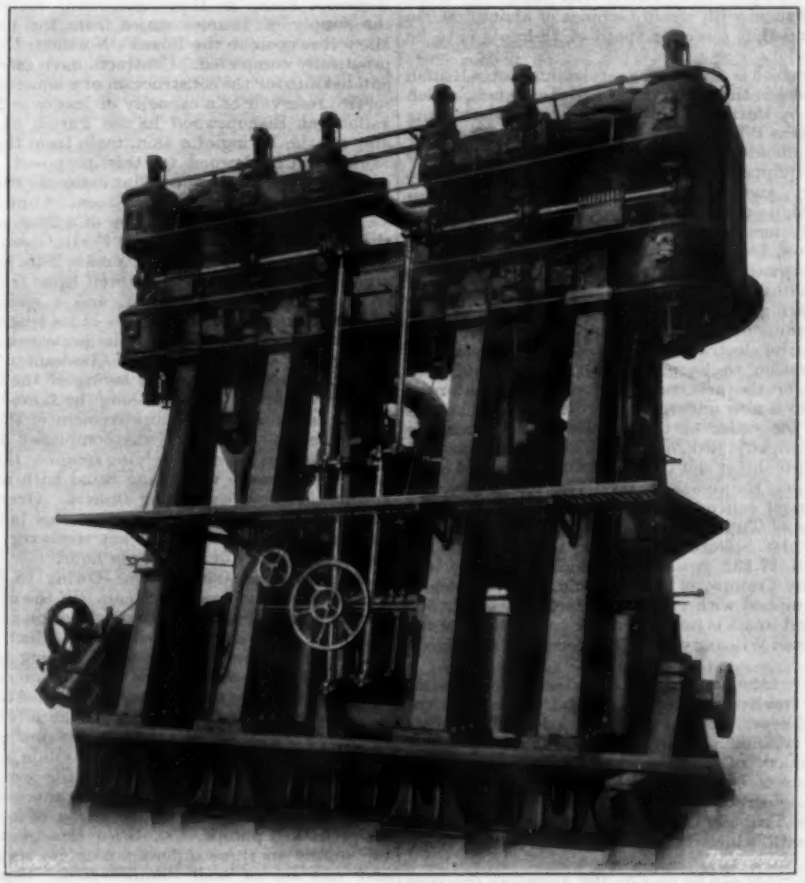


FIG. 7—1700 I.H.P. DOUBLE COMPOUND LENTZ MARINE ENGINE

shallow banks giving deep V-shaped openings to the bottom of the condenser, and corresponding inverted V openings on the underside of the tube banks. It is claimed for the system that, as there is very little resistance to the steam and incondensable vapours passing through the shallow banks of tubes, kinetic energy is used to give a compression effect to the incondensable gases at the bottom of the condenser, and an increment of heat to the condensate, the compression effect being enhanced by the unrestricted fall of condensate through the inverted V-shaped openings. In practice, temperatures higher than those of the entering steam have, it is stated, been obtained, with an absolute pressure at the condenser bottom even slightly higher than that at the inlet. For some installations a transmission rate of 1000 B.Th.U. per square foot per degree temperature difference has, we understand, been obtained. The Mirrlees Watson Company, Ltd., is supplying a marine condenser of this type to Swan, Hunter and Wigham Richardson, Ltd., while John Dickinson and Son, of Sunderland, are constructing a similar condenser under licence which will be equipped with a Mirrlees air and condensate pump.

Some Important Ships Constructed Abroad.

In our special Supplement which accompanies to-day's issue we illustrate the French liner Ile de France. She was built at the Penhoët Shipyard, St. Nazaire, to the order of the Compagnie Générale Transatlantique, and with her three red and black funnels presents a handsome appearance. The hull has an overall length of about 760ft. and the gross tonnage is 43,500, which makes the liner the largest constructed since the war. Parsons turbines of the direct-coupled type arranged on four shafts propel the ship, and their total output is about 52,000 S.H.P. Steam is raised in twenty oil-fired boilers of the Proudhon-Capus type. The Ile de France has made several successful voyages during the year and her service speed is about 23 knots.

A notable addition to the fleet of the Hamburg-South American Line was the 27,000-ton 680ft. twin-screw liner Cap Arcona, built by Blohm and Voss, of Hamburg. She is propelled by 24,000 S.H.P. single-reduction geared-turbine machinery designed to give the ship a speed of about 20 knots. Water-tube boilers for a working pressure of 280 lb. with 600 deg. Fah. total superheat are installed. In Germany considerable interest attaches to the two 43,000-ton North German Lloyd liners, the Bremen and Europa, which are being built at Hamburg and Bremen for express Atlantic service. It is stated that these two ships will be engined with steam turbines of about 100,000 S.H.P. and that a service speed of 26 knots is to be aimed at.

A ship which is of more than usual interest to British shipbuilders is the 30,000-ton liner Statendam, which was built by Harland and Wolff, Ltd., and is now being completed at Wilton's Yard at Rotterdam to the order of the Holland-America Line, Ltd. The Statendam will be equipped with high-pressure geared turbine machinery, and Harland and Wolff, Ltd., are building the high-pressure turbines. Water-tube boilers, as already mentioned, will be supplied by Babcock and Wilcox, Ltd. When the vessel is ready for trials more information regarding the design of her engines will be published.

The placing of the order for the new P. and O. liner and the announcement that she will be propelled by B.T.H. turbo-electric machinery has caused considerable attention to be paid to the design and construction of the new turbo-electric liner California, which ship is now undergoing her sea trials. She was built to the order of the International Mercantile Marine Company, Ltd., of New Jersey, by the Newport News Shipbuilding and Dry Dock Company, and a full description of the vessel, her propelling machinery, and her electrical control arrangements will be found in the issues of THE ENGINEER for September 9th and October 21st. During the year the Matson liner Malolo, of 17,232 gross tons, which was built and engined by Cramps, of Philadelphia, was completed. She is equipped with geared turbines of some 12,500 S.H.P., and steam is raised in water-tube boilers of the Babcock and Wilcox type. The speed of the Malolo is 21 knots.

Another American ship which must be included in our brief review of progress is the pulverised coal burner Mercer, which recently made an excellent Atlantic crossing in rough weather. We described the machinery of the Mercer in an article published in our issue of December 16th, and it may be stated that an English company will shortly be formed under the style of Peabody Ltd., to develop the Peabody coal burners with which the boilers of the Mercer were equipped.

Little further can be said on the American proposal to construct a fleet of fast Atlantic liners which will make the crossing from New York to an English port in four days. The technical problems of such a proposal, particularly as regards the high power and heavy fuel costs for such a high speed, are not without their own difficulties, and it will be interesting to see if they can be solved in a manner which will not impair the economic value of the ships should they be built.

A BEET sugar factory is to be put up at Brigg, Lincs., at a cost of £350,000. Seventy-five per cent. of the machinery will be made in this country.

Water Supply in 1927.

No. I.

Introduction.

A VERY considerable quantity of water engineering is proceeding in this country and throughout the world, not only in connection with potable supplies, but also for irrigation purposes. It would be impossible for us to give anything like a complete list of all the undertakings which are being carried out, in this country alone; nor shall we attempt to do so, but shall confine ourselves to mentioning just a few among them. It would be even more impossible to refer, however briefly, to everything which is going on abroad, and in this direction, too, our remarks must, necessarily, be limited. In irrigation alone a vast amount of work is in hand in various parts of the world—India, Australia, Africa, and in North and South America. Perhaps the outstanding event of the year in that connection was the commencement of the Nag Hammadi barrage on the Nile between the Assuan Dam and the Assiut Barrage. The total length of this structure between the abutment piers is to be very nearly 2700ft., and when it is completed a large area of land, which is now under flood basin irrigation and which at present may not even receive sufficient water during the flood season, or may, perhaps, be left entirely unwatered during low floods, will always receive its full quota of water.

Several new waterworks were begun and several were completed and put into service during the year. Many others made considerable progress, while very many more passed through their initial stages and will be proceeded with in the present year.

Metropolitan Water Board.

Works in Connection with the Supply from the Queen Mary Reservoir at Littleton.—The construction of the new pumping station at Kempton Park was completed so far as the building itself is concerned. The installation of the boilers was also almost finished, and the erection of the vertical triple expansion engines and single acting plunger pumps is well in hand. A contract was entered into for the construction of twenty-four open rapid gravity primary filters at Kempton Park, and their installation and the accessory work in connection with them are in hand.

Works for the Improvement of the Supply North of the Thames.—The laying of a main from Albert-road, Regent's Park, to Brecknock-road, Holloway, for the supply of Thames water from the new Queen Mary Reservoir to the Board's Northern District was practically completed. Contracts have recently been entered into for the construction of a concrete covered service reservoir of a capacity of just over 20,000,000 gallons at Bishopswood in the Parish of Hornsey, and for the laying of a 48in. main from the Board's works at Cricklewood to this proposed reservoir, continuing beyond as a 42in. main to the Board's existing reservoir at Fortis Green. Contracts were also entered into for the laying of a 24in. main from the Board's pumping station at Fortis Green to Southgate Reservoir, and for laying a main 20in. in diameter along the new Cambridge Arterial Road from Enfield to Brookfield-lane, Cheshunt, and a main 14in. in diameter, reduced for a portion of its length to 12in. diameter, along that lane for the improvement of the supply to the Urban District of Cheshunt.

Works at Hampton.—The laying of the 48in. cast iron filtered water conduit along the Lower Sunbury-road, Hampton, for the improvement of the draw-off from the existing filters was completed during the year. The ten boilers supplying steam to the "Riverdale" engines are now being fitted with mechanical automatic smokeless coking stokers. Overhead coal bunkers are also being erected at this boiler-house, together with a gravity bucket conveyor, having a carrying capacity of 12 tons per hour.

Deptford Pumping Station.—Owing to the age—in some cases over seventy years—of the engines and pumps at the Deptford pumping station it has been decided to re-model the whole works, which consist of five separate pumping stations pumping from three wells, and to concentrate the work in one new pumping station with resulting economies in fuel and labour. Tenders have been invited by public advertisement for one vertical triple-expansion engine capable of performing—when pumping 12·0 million gallons per twenty-four hours—the whole of the work of this station and provide for future requirements. This engine will drive four separate sets of three-throw reciprocating pumps, *i.e.*, three sets of pumps for the supply to three different pressure service zones and one set of well pumps—200ft. head—driven direct from the engine crossheads and those supplying the intermediate—300ft. head—and high pressure—400ft. head—zones from beams operated by the low-pressure zone pump crossheads. The well pumps will be situated in a new well which is to be constructed and connected by adits to the three existing wells, and will be driven through a clutch from an extension of the engine crank shaft.

The Taf Fechan Reservoir and Works.

ONE of the leading events of the year was the putting into service of the Taf Fechan reservoir and its accessory works, which took place in July. The reservoir, when full, contains no less than 3400 million gallons of water and forms a lake with a surface area of 349 acres. It is formed by an earthen embankment with a clay puddle water having a concrete tongue at the bottom. The embankment is 1010ft. long and 107ft. high and the top level of the impounded water is 1082ft. above Ordnance Datum. A feature of the structure is the overflow shaft. The embankment is not provided with a spillway and the whole overflow from the reservoir passes down through a circular vertical shaft 16ft. in internal diameter with a widely splayed bell mouth having a diameter of 66ft. at the top, which discharges into the outlet tunnel. There is a draw-off valve tower inside the embankment with three outlet pipes with their centre lines arranged at 1059ft., 1034ft., and 1009ft. respectively, above O.D. The compensation water which has to be passed downstream amounts to 6,835,000 gallons in the twenty-four hours, and is led through two turbine units, coupled to electric generators, each turbine being of 75 B.H.P. and each being designed to operate under heads varying between 50ft. and 100ft. The water flowing from the reservoir is soft and of great purity, but it is frequently peat-stained, and that fact led to the provision of a treatment and filtration plant which, at present, has a capacity of 7,500,000 gallons per day, but which can readily be enlarged so as to deal with the full flow which the reservoir is capable of yielding, *i.e.*, 12,000,000 gallons per day. Sulphate of alumina and lime are employed in the treatment of the water. The aqueduct leading from the treatment works consists of steel pipes lined with cement mortar. Altogether, with the branches, over 20 miles of pipes, varying in diameter from 36in. to 6in., had to be laid and several important river and railway crossings had to be negotiated.

Newport.

At the end of September the new source of water supply for Newport, Mon., from the Talybont watershed was formally put into service. The complete scheme embodied the construction of an impounding reservoir to contain 2,500,000,000 gallons, the laying of a pipe line, in duplicate, from it to Newport, and the construction of a service reservoir to contain 10,000,000 gallons at Llantarnam. At the point fixed upon for the abstraction of the water from the river Caerfanell at Talybont the flat land in the valley is about 1200ft. in width. It was decided, as a first instalment of the work, to construct a weir across only 350ft. of the river and to extend it across the remaining 850ft. as and when such work became necessary. As a result a quantity of at least 1¼ million gallons of water a day on an average of drought was made available, which, with the pre-existing supplies, brought the total available quantity of water up to some 4¼ million gallons per day, and that is more than enough to meet the needs of the town for some time to come. The water after being taken from the river passes to a filtration plant, where it is treated and filtered and from which it flows to a supply basin. From the latter it enters the pipe line to flow to Newport, a distance of some 34½ miles. At present only one line of pipes has been laid. At the end of 25 miles there is a break pressure tank near Pontypool-road station. At the moment a service reservoir of only half the designed capacity has been constructed at Llantarnam. It holds 5 million gallons, which is sufficient to serve the first line of pipes.

Belfast: Silent Valley.

As we announced in our last annual article, trouble, due to unsound rock, had caused a temporary stoppage of work on the foundation of the core wall for the dam which Belfast was constructing in the Silent Valley. The matter was referred to a consultatory board of engineers and during the year considerable progress was made with the exploratory work undertaken under the direction of that board in order to ascertain whether it would be feasible to construct the embankment at the site originally selected. The board of engineers delivered its report towards the end of December, and it is expected that a decision will be arrived at shortly.

Birmingham.

Considerable progress was made during the year with the construction of the Bartley reservoir, an illustrated description of which appeared in our issue of February 18th last. The main embankment is now within about 21ft. of the top. The whole of the core wall is completed, and about one-half of the concrete diaphragm wall has been built up to the full height. In the bed of the reservoir about 72 per cent. of the area has been covered with either concrete or beaching. The 6ft. diameter pressure tunnel has been completed and the mains for conveying the water from the reservoir on to the existing Frankley filters are laid. Generally speaking, nearly three-quarters of the work has been done.

The Water Department made good progress during the year with the laying of 60in. diameter concrete-lined steel pipes forming the third main on the Elan aqueduct. The length that was laid during 1927 was just over 2½ miles.

(To be continued.)

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

Prospects for 1928.

CONSIDERABLE caution is displayed by leaders of industry in the Midlands and Staffordshire when speaking of the trade prospects for the current year. They admit that many of the portents are favourable to a general improvement in industry, and that trade slowly improved during the past year, culminating in excellent returns for the month of November. They consider it unwise, however, in estimating the probable course of events in the future, to place much reliance on the trade returns for a single month. The November statistics, it is agreed, provide an encouraging incentive to fresh enterprise and endeavour, but that is as far as they are prepared to go. The past twelve months of persistent endeavour failed to disperse the cloud which overshadows the iron and steel industries, but the view is expressed that while there is nothing which justifies any expectation of a "boom" trade in the year now opening, the steady, slow improvement of the last few months should be increasingly maintained. It is pointed out that two essentials to a retu n of flourishing conditions in the staple industries of the Midlands are decreased production costs, to enable manufacturers to compete successfully in the world market and greater efforts than ever before on the part of manufacturers to improve their export trade. While some industrialists say they perceive definite signs of progress, and claim justifiable optimism regarding the prospects of 1928, the majority merely express a confident belief, based more on sentiment than actual signs, that the year will witness some further recovery in British trade, and a hope that in that recovery the iron and steel and heavy engineering industries of the Midlands and Staffordshire will share.

Iron Trade Hopes.

Staffordshire ironmasters take a hopeful view of the prospects for the ensuing year. The industry has for a long time been under a cloud, but recently makers of best iron have been getting good orders for shipbuilding and railway work, and they were able to commence the year with fairly substantial business on their books. Moreover, they feel assured that the demand for their products will be greater this year than last. Not only should the two industries mentioned above require much additional material, but certain of the engineering trades ought to be good customers. Engine shafts, staunchions, and other essentials in which superior quality material is necessary are increasingly made of Staffordshire iron, which has held a reputation second to none for so long a time. As I pointed out in this letter some weeks ago, wrought iron is also being increasingly used for the manufacture of gas tubes, the tendency to stipulate wrought iron tubes in gas company and corporation contracts having been most noticeable of late. Manufacturers of cables, chains, anchors and other equipment for ships report rather more activity, and contracts for material are under negotiation. Ironmasters are determined to make the most of their opportunities, and are not waiting for business to come to them. In this connection it is interesting to note that Colonel Trinham, managing director of Noah Hingley and Sons, Ltd., of Netherton, is setting out on a tour of the Indian railways for the collection of business, which he hopes will come practically from all lines. The nut and bolt and fencing trades of the Black Country are experiencing more active conditions, but Staffordshire ironmasters cannot look forward with much optimism to this branch of business as foreign competition puts them right out of the market. This week has witnessed quite an accession of business in the marked bar branch. The wide disparity which has existed for some time between best material and lower qualities has been lessened by Staffordshire ironmasters reducing the price of marked bars by 10s. per ton, putting them on the basis of £12 10s. per ton, or £2 per ton below the figure ruling a year ago. Consumers who had been withholding contracts, heartened by this action, entered the market, and the forward position o local ironworks was accordingly strengthened. The call for Crown quality bars remains poor, and values range from £9 5s. to £10 5s., the latter being the Staffordshire quotation. Some local makers indeed claim to be able to obtain £10 10s. for Crown bars, and the fact that in other quarters supplies are offered at £9 5s. is attributed to the absence of any definite standard of quality. Nut and bolt and fencing bars are quoted £9. There is a ready sale for wrought iron gas tube strip, the price of which is firm at £11 10s. Twelve months ago this material was making as much as £15 per ton.

Pig Iron Position.

Midland smelters with a very bad year behind them are anxiously looking for definite signs of expanding demand. The immediate prospects cannot be described as healthy, and blast-furnacemen on Birmingham Exchange are nearly discouraged. Many furnaces are idle, present prices are stated to be unremunerative, and consumers, instead of placing bulk orders, as it was thought they would do as soon as the New Year opened, continue to give out their work in driblets, at the same time clamouring for better terms. Producers maintain that any further price concession would increase their losses, and that the volume of new business which the reduction in price might result in would be insufficient to justify them in increasing production. They assert, on the contrary, that unless business improves they must blow out further furnaces. They have not the same confidence in the future as they displayed at the opening of last year, when blast-furnaces were put into action as quickly as coke could be obtained to feed them. No fewer than 111 were recommissioned in the first four months of the year, making a total of 189 active furnaces Then business began to fall away, or rather the old orders had been cleared off and the new business was insufficient to keep the furnaces going. The market began to decline, and furnaces were blown out again, and the year ended with only 155 furnaces in operation. With such an experience there is no wonder that furnacemen look to the future with caution, hope, and limited enthusiasm. There was only a faltering demand on 'Change in Birmingham to-day, and the chance of good business developing between now and next week's quarterly meeting does not appear great. Quotations are practically unchanged. If there is any slight weakness it is in regard to Northamptonshire makes. Derbyshire furnacemen resist the pressure by buyers for concessions. Northamptonshire No. 3 foundry is quoted £3 upwards, forge, £2 14s.; Derbyshire foundry, £3 5s. 6d. upwards; forge, £2 19s. Midland consumers were able to buy West Coast pig at a reduction of 2s. per ton on recent rates, viz.:—£4 8s. 6d. delivered Birmingham. A moderate amount of low-phosphorous iron from Barrow is used in this district, and the concession will be welcomed by high class founders.

Blast-furnace Coke.

Blast-furnace coke is in slow demand, despite the fact that it is now procurable at 12s. per ton, as against 20s. in January last year, and 22s. in April. Ovenmen were sounded to-day as to future prices, but they seemed disinclined to make any announcement at the moment. They believe consumption will be very materially increased in the near future, but ironmasters do not share their optimism.

Brighter Steel Outlook.

There are evidences that the year 1928 will bring better business to the Midland steelworks. The engineering industries and other users of steel are for the most part contemplating increased business necessitating larger calls upon the steelworks than has been the case of late. The shipbuilders have had more orders, constructional and electrical engineering firms are reported to be booking new business, while large quantities of steel, it is estimated, will be required for ferro-concrete building schemes. Pipe foundries and tube mills have had a good flow of trade recently, and it is considered probable it will increase rather than decline. Much material will be required by the motor-car builders. The heavy engineering industries, apart from shipbuilding, however, are still very much behind their pre-war standard of consumption, while productive capacity at the steelworks has increased enormously. The keen competition which steelmasters have had to face during the past year is likely to be maintained. Reliable news as to the result of the steel rebate scheme, which came into operation at the beginning of September, should be available at the end of the month. By then it should be known how far the steelmakers' claims to success have been justified, and how far they have succeeded in inducing British engineers and other consumers of steel to refrain from the use of foreign material. Constructional engineers on 'Change in Birmingham this week gave it as their firm conviction that the railways will want a good deal of steel early this year, and that orders will be given out because of the improbability of lower prices. There is an immense amount of construction to be done in rolling stock and in the rebuilding of stations, all of which will provide work for local steelworks. Prices quoted to-day for structural steel were firm and on the recent basis, angles and joists, £7 12s. 6d.; ship, bridge and tank plates, £8 7s. 6d.; boiler plates, £11. Values are some 20s. below those of last January. Staffordshire steel hoops are quoted £10 10s. at works, small bars rolled from continental billets £8 7s. 6d., or from British material £8 17s. 6d., mild steel billets £6 delivered in the district.

Galvanised Sheet Trade.

Midland galvanised sheet mills start the New Year in much the same position as twelve months ago. They are not at all well off for orders, and though inquiries are said to have been fairly numerous on 'Change in Birmingham this week the new business given out was small. Galvanised corrugated sheets of 24-gauge, which a year ago were making £16 5s., are now down to as low as £13 for export and £13 2s. 6d. for local consumption. Demand both on home and export account, however, drags badly. Makers have no difficulty in securing adequate supplies of raw materials at the right price. They are of opinion that an early spurt in buying is to be expected, and it is also considered probable that this will be the signal for values to rise from their present low level.

Scrap.

Birmingham dealers in heavy scrap have benefited from the recent improvement in the tin-plate trade, which necessitates the use of more semi-finished steel. They have so far been unable to secure better prices, but they are considerably reducing their stocks.

Engineering Possibilities.

The New Year begins with rather brighter omens in the various branches of the engineering industry in the Midlands. A partial revival in the shipbuilding yards promises to develop greater proportions, resulting in additional work coming to Black Country manufacturers of chains, cables, anchors, nuts and bolts, and ship fittings. Constructional engineers on their return after the holiday found inquiries awaiting them from which they hope to secure business. Hopes are vested in the railway requirements, which will be large when the companies realise that nothing is to be gained by further waiting. A great many bridges and stations require to be rebuilt, and the stores are becoming empty. It is known that some constructional engineers, though they have been booking only light tonnages recently, have sufficient work on hand to keep them going for some time. Engineers in the Midlands have during the past year had sub-contracts in connection with some of the great undertakings, but they have had little chance of recovering the export trade which they used to do on their own account. The advantages enjoyed by competitors on the coast have been tremendously accentuated by the increase in transport costs. Such orders as were taken by Midland bridge builders last year were not of any magnitude, but compensations were found in the active demand for ferro-concrete construction. The electrical engineering trade has been good throughout the year, and prospects remain more favourable than in perhaps any other branch of engineering. Works are now engaged in producing a vast amount of generating plant for new super-stations and incidental equipment for transforming and distributing current. Important schemes abroad, as well as at home, have been kept going. Railway electrification is also providing considerable employment, and will provide more in the year on which we have just entered. The electrification of industry has made progress, particularly in Birmingham. It is accompanied by a greater demand for small motors, but the stimulus given to this department is not so great as had been hoped for. Mechanical engineers are not well placed for business, orders of late have been variable, and while the engineering shops have been kept going, the future is not at all clear. Orders should, however, be forthcoming for power-house equipment, pumping plant and requisites of the motor engineering shops. Black Country boilermakers are extremely busy. Several firms have never had a greater demand, and the activity is largely shared by those devoted to the covering or the fitting of boilers.

Automobile Engineering.

Midland automobile engineers welcome the New Year, for in most departments, after a difficult and in some cases disappointing year, they have hopes of a fairly good run of business. It is confidently anticipated at Birmingham, Coventry and Wolverhampton that some excellent business will this year be forthcoming, both from home and export markets. Some unusually good contracts for heavy vehicles have already been given out, while agents' reports indicate the probability of a big run in the spring on light cars. An improvement in trade is confidently forecasted, but nothing in the nature of a "boom" is looked for, circumstances being against such a development. The commercial vehicle section of the industry has perhaps had the best run of business during the past year, and there is reported to be an increasing demand for lorries and for motor omnibuses for private and municipal services at home, and also for overseas. The motor coach business, another branch of the industry which has undergone wonderful development, is, of course, more seasonal, but local manufacturers report favourably in this department. It is recognised that competition will be as keen as, if not keener, than ever this year, but every opportunity is being taken by local motor engineers of improvements in the method of production, working costs being reduced to a minimum. At the same time the high quality of their products is not to be sacrificed, and where modern mass production methods are considered likely to reduce quality, they are not adopted. Taken on the whole, and judging from present signs, Midland automobile engineers should, given freedom from industrial unrest, have a fairly successful year.

Machine Tool Industry.

The machine tool trade—an important Midland industry—has had a busy and successful year, and the prospects for 1928 are most encouraging. During the past year there has been a growing demand for up-to-date labour-saving devices, and the demand gives every evidence of continuing. The keen competition existing in the motor trade has caused manufacturers to seek every means of reducing production costs by the installation of the latest types of labour-saving machinery, and Midland machine tool makers have proved their ability in this direction, and have had little difficulty in satisfying their customers' needs. The call for machine tools for abroad has not expanded much, exports being about the same as in 1926. The outlook in this direction, however, is said to be quite promising.

Cannock Chase Mining Losses.

Under the new ascertainment based on the results of the local coal industry during September, October and November, the wages of miners in the Cannock Chase and Pelsall districts during January will remain for the seventh consecutive month at the minimum in accordance with the local agreement. This is 42 per cent. of the basis rates, and the real ability to pay is only 7·89 per cent., compared with 9·89 per cent. at the December ascertainment. The stallman's minimum wage per shift is therefore 9s. 4d., and for other grades of men down the pit 8s. 10½d. to 7s. 3d. The owners' accumulated deficit, which stood at £735,590 last month, has now increased to £928,764. Last month there was a loss of 1s. 4·92d. on every ton of coal produced in the Cannock Chase area, compared with 11·83d. in the previous month, and 9½d., 8½d. and 10½d. in the preceding three months.

Worcester and Electricity.

The demand for electricity in the Worcester area is increasing so rapidly that the Worcester City Council, I learn, proposes early this year to approach the Electricity Commissioners for sanction to a loan of £35,000 for electric mains, transformers and sub-station equipment in the city, and transmission lines and switch gear in the extended area. Of this sum £26,500 will be required for the city area, and £8500 for the country area.

LANCASHIRE.

(*From our own Correspondents.*)

MANCHESTER.

Prospects in Engineering.

MOST of the statements that have been made during the last few days concerning the prospects in the engineering industries are extremely hopeful, although in some cases, notably in the textile machinery branch, opinions as to the outlook are by no means unanimous. One of the leading Lancashire firms of textile machinists states that it has been running "full shop" practically throughout the past year and regards the outlook as promising, its foreign orders including many from the Continent and the Far East, but none from Russia. The views of another firm of textile machinery manufacturers

are couched in similar hopeful terms. In some cases, however, the unfavourable developments in connection with trade relations between this country and Russia in the first half of last year had a more serious effect than in others, although pretty well every firm of textile machinists suffered to a greater or less degree. In one such case it is stated that whilst production was at a fairly steady level from month to month during the past year, there are no signs that there will be any change for the better this year. The trade of this particular firm with Russia, which was steady before the breach, has been killed altogether since, and, failing a resumption of trading relations with that country during the present year the outlook is regarded as not very good. Generally speaking, however, the prospects of the general and electrical engineering industries of the district have provoked favourable comment. The same may be said respecting the outlook for the industries of Liverpool and district. In the case of shipbuilding and ship repairing, in particular, the employment position is better than it was twelve months ago, and Cammell Laird and Co., Ltd., of Birkenhead, have a fair amount of business on their books.

Electricity Mains and Omnibuses.

Further substantial expenditure on electricity mains and motor vehicles was sanctioned by the Manchester City Council at its monthly meeting this week. The Electricity and Finance Committees submitted reports on proposals for work on the ordinary electricity mains, which will involve the expenditure on loan of about £250,000. The Tramways Committee secured approval of a resolution authorising an application to the Ministry of Transport for sanction to borrow £69,000. Of this sum it is proposed to spend approximately £30,000 for the purchase of an additional twenty motor omnibuses which the Authorities consider will be necessary in the near future, the balance of £39,000 being required for the acquisition of additional motor vehicles, for the permanent way and overhead equipment work and for the parcels department.

An Engineering Merger.

Three Liverpool and Birkenhead engineering concerns are involved in an amalgamation which operates as from the beginning of the present month. These are H. and C. Grayson, Ltd., Clover, Clayton and Co., engineers and shipbuilders, and David Rollo and Sons, marine and general engineers. The title of the new concern is Grayson, Rollo, and Clover Dock, Ltd., with central offices in Liverpool.

Non-ferrous Metals.

Operations in all classes of non-ferrous metals since my last report have, of course, been on a much reduced scale. Weakness has been a feature of the tin section, but, with this exception, values on the re-opening of the market on Tuesday after the long week-end were steady to firm, compared with the closing quotations at the end of last week. In no instance has there been much buying interest, but in the case of tin the quiet conditions have reacted on prices, and on balance values are rather substantially lower than they were a week ago. So far as copper is concerned, a markedly firm attitude on the part of sellers has served to neutralise any weakness which, in the absence of anything approaching active buying conditions, might have developed, and quotations at the time of writing represent a considerable improvement on the week. Although the outlook for spelter is somewhat uncertain and there is no sign at the moment of supplies in the near future being less freely obtainable, values have kept fairly steady, with little movement either one way or the other. In the case of lead the demand from the consuming industries has been on a moderate scale, and a slight recovery has been effected.

Iron.

Although it can hardly be said yet that the iron and steel markets have settled down to where they were before the holidays, there is no great change in basic conditions, so far as foundry iron is concerned, compared with those that obtained in December. Actual demand since the resumption has been on a very quiet scale, but as buying interest in this section almost throughout the closing month of the year was very dull, the position at the moment is little, if any, worse than it was then. Resumption of contract buying on a freer scale is regarded as overdue and an improvement in this respect is looked for during the current month. This week forward commitments have been limited to a few actual orders placed, with a moderate sprinkling of inquiries in circulation. On the whole, there has not been a great deal of alteration from the point of view of prices. Staffordshire brands, for delivery in this area, are obtainable at about 72s. 6d. per ton, Derbyshire at from 73s. to 73s. 6d., Middlesbrough at 78s., Scottish at 88s., and hematite at 85s. The demand for manufactured iron remains on a very poor scale, though Lancashire makers are still quoting £10 per ton for Crown bars and £9 10s. for second quality material.

Steel.

For most varieties of steel inquiry is slow. Sellers, however, although they see little immediate prospect of a renewal of contract buying, which was conspicuously absent virtually throughout the closing half of the past year, are hopeful of putting through a steady aggregate tonnage in the shape of near delivery parcels when the market has fully settled down again. There is still a certain amount of weakness to be observed in boiler plates and also in steel bars. The demand for the former is quiet, and very patchy; offers of basic plates range between £10 and £10 5s. per ton, with acid varieties quoted at about £10 10s. Small re-rolled steel bars are usually at £7 10s. per ton, but it is possible here and there to find this price cut to the extent of a shilling or so; large sizes are about unchanged at £8 10s. Tank plates continue to be offered at £8 7s. 6d., and sections at £7 12s. 6d. The market for imported steel is a shade easier, and little important buying is going on. For delivery to Lancashire works, for cash against documents, continental makers are quoting joists at £5 12s. 6d. per ton, ordinary plates at £7 2s. 6d., Siemens plates at £7 10s., angles at £5 16s., wire rods at £6 7s. 6d., steel bars at £5 18s. 6d., billets at £4 19s., and sheet bars at about £5 per ton.

BARROW-IN-FURNESS.

Hematite.

The holidays naturally affected the market, and there is at the moment a duller tone than ordinarily. Trade seems to be confined to orders placed by customers for immediate delivery. There is no inclination as yet to place orders for forward delivery. The number of furnaces in blast in the district remains at eleven, with an additional furnace at Backbarrow, which is engaged on turning out special qualities of iron for which a steady market is found. The furnace which was put in at Millom a month or two ago, just at the time when other works were damping down, is still employed. The secret of Millom's success in securing orders at the present time may be due to a certain extent, it is stated, to the fact that its owners are also owners of the Florence Pit, Cumberland, and interested in foreign mines. This fact, combined with the economical production at Millom, accounts for putting another furnace in blast, when others, being overstocked, were compelled to cease production. The iron ore trade is moderately employed. Very little is going out of the district. Foreign ore is being imported in restricted quantities. The steel works at Barrow have restarted, and the merchants, Siemens, rail and hoop departments are all engaged. The outlook is moderately good, and orders are held which will keep the mills employed for some time.

SHEFFIELD.

(From our own Correspondent.)

Iron and Steel Position.

THE year has opened with very unpromising conditions in the heavy iron and steel trades. Many of the important works have had to take an unusually long holiday, which in itself is an indication of the poor state of trade. A particularly depressed section is basic steel, and when work is fully resumed it will probably be found that there are less open-hearth furnaces in commission than at the end of December. Makers continue to complain of the severity of foreign competition, and, as they are still being undersold to a considerable extent, the depressed state of the bulk steel industry looks like continuing for some months at least. The rollers of bars, strip and rods are also short of work and they continue to complain of the smallness of the orders placed with them. It is a rare thing, in these days, for a mill to get a good long run on one order, and without work of that description it is extremely difficult for managers to run their plant profitably. The many firms in Sheffield and the surrounding districts which specialise in railway material are hoping for a busy year. A lot of work anticipated last year was not placed, but it is pretty certain that the bulk of the postponed contracts will have to be placed in the near future. The crucible steel trade has had a lean time for some years, but there is a widespread feeling that this year will see an improvement. Prices of iron and steel remain as before the holidays, but several important controlling associations will be meeting in the course of the next week or two, when the position will doubtless be reviewed. With the exception of hematite pig there has been very little contracting forward for raw material, though the general feeling is that no further concessions will be given by the sellers. On the contrary, it will not be surprising to find prices advancing.

Engineering Departments.

Whilst no particularly noteworthy contracts are being talked of at the moment, practically all the large firms are securing some useful orders in engineering lines. It is true that there is only a poor call for heavy forgings and castings—and the position is not likely to improve very much under present conditions—but that is being partly counteracted by the greater activity in the lighter branches of work. Most of the Sheffield firms are now working with modernised plants, and it is gratifying to learn that their enterprise is being rewarded, and that they are more than holding their own, both in the matter of price and quality. Two trades that continue to be excellent customers of Sheffield are the electrical and motor trades, and there is not only a good deal of work from those sources now in hand, but the prospects are also undoubtedly good. The coming twelve months will probably see a very large output of steel and castings for these developing industries. Increasing interest, too, is being taken in the application of stainless steels. In this direction Sheffield is undoubtedly still the leader, and research work during last year has been remarkably successful in making possible the wide application on a commercial basis of these steels.

Tools, Plate, and Cutlery.

Conditions in the tool trades are somewhat uncertain and work is coming through in irregular fashion. Files and certain other classes of tools experienced depressed trade conditions during the greater part of last year, and while immediate circumstances do not indicate any great change, makers are not without hope of improvement. A good deal will depend upon the development of trading relations with Russia. There is no doubt that the differences of opinion between the British Government last year and the Soviet lost Sheffield and district a good deal of trade in steel and tools, and there is a strong feeling in the district that this year the Russians will be prepared to resume buying from this country. If so, it will make a big difference to the local trades. Cutlery and plate manufacturers are finding conditions very quiet, which is usual during January. Very little trade is coming from the shopkeepers, but there are several large contracts for catering concerns in course of completion. On the whole, the trade for the Christmas season may be considered good, and it is believed that the output, particularly of cutlery, has been unusually heavy.

Changes and Developments.

Two announcements of great interest in local industrial circles was made at the end of the year. Mr. A. O. Peech, who has been chairman of the United Steel Companies, Ltd., since 1920, has found it necessary, through ill-health, to ask to be relieved of some of his responsibilities, and he has therefore relinquished the chairmanship. He has taken the position of president, retains his seat on the board, and will continue to assist the company. The board has elected Mr. W. Benton Jones, of Sheffield, to be chairman of the company, and Mr. R. S. Hilton, deputy chairman of Metropolitan-Vickers Electrical Company, Ltd., has accepted the appointment of sole managing director of the United Steel Companies. The other announcement concerns two well-known Sheffield firms—Thos. W. Ward and Co., Ltd., and the Sheffield Coal Company, Ltd. It will be remembered that last July the Railway and Canal Commission approved the amalgamation of the Aston Coal Company, Ltd., and the Sheffield Coal Company, Ltd., under the Mining Industry Act, 1926, and the Treasury guaranteed a loan of £250,000 for the development of collieries on condition that the Sheffield Coal Company, Ltd., raised at least £200,000 of additional capital. In this connection, Thos. W. Ward, Ltd., has acquired a considerable financial interest in the Sheffield Coal Company, and the chairman—Mr. Joseph Ward—becomes a director on the board of that company. The coals from the Parkgate, Silkstone, Barnsley and Hazel seams are noted for their household and industrial qualities, and under ordinary conditions command a ready sale. Thos. W. Ward, Ltd., has taken over the Sheffield Coal Company's sole selling agency, both for coal and coke, in Sheffield and district, and there will be no change in the representation, as Mr. F. Johnson, the former representative, has been taken over with the agency. This arrangement between the Sheffield Coal Company, Ltd., and Thos. W. Ward, Ltd., is an indication of the efforts now being made to produce and market coal on an economic basis, and should be to the mutual advantage of producer and consumer.

Low-temperature Carbonisation.

It was announced at the annual meeting of Low-temperature Carbonisation, Ltd., that an agreement had been reached with the Askern Colliery, near Doncaster, for the erection of a plant to work the low-temperature carbonisation process. This plant is to be capable of dealing with 500 tons of coal a day. It was also stated that the company was negotiating with several other important collieries, which have signified their intention of establishing plants. Askern Colliery, by the way, has recently experienced difficulty with faults, but a drift through one of them has enabled the Barnsley bed again to be reached. Should a second drift prove equally successful, there is every chance of considerable developments being carried out at the colliery.

New Goole Sidings.

The executive of the L.M.S. Railway has approved a scheme of additional siding accommodation at Goole, and the work will be put in hand at an early date.

NORTH OF ENGLAND.

(From our own Correspondent.)

Progress Towards Prosperity.

THE New Year has opened with an optimistic tone in industrial circles in the North of England. Nothing in the nature of a boom is anticipated nor desired, but all the indications point to a steady improvement in trade generally. The struggle of iron and steel manufacturers during the past year to meet the intensification of foreign competition, which has confronted them since the end of the post-war boom, has met with gratifying success, and the annual statistics reveal some interesting and encouraging facts. Both with regard to pig iron and steel the North-East Coast is the premier producing area in Great Britain, one-fourth of the steel and one-third of the pig iron made in the United Kingdom being produced on Tees-side. Another remarkable fact is that the exports of manufactured iron and steel from the Tees during the past year have established a record in the history of local industry. It cannot be said, however, that all is well in the iron and steel industry. Indeed, the imports have slightly exceeded the exports, but there was a definite adjustment of the balance in the later months of the year, and there are signs that, in the future, more will be exported than imported. Overseas markets are gradually being recovered, the home market is being recaptured, and altogether there are indications of a better time ahead.

Iron and Steel Exports.

The shipments of pig iron from the river Tees during 1927 reached the smallest tonnage on record, except in 1921, the year of the coal strike. Even though six months' production was lost in 1926, owing to the second coal strike, more pig iron was shipped from the Tees in that year than in 1927, yet the total of 163,000 tons represents no more than one-eighth of the average pre-war figure. The fact is, however, that the staple industry of Cleveland is in a state of transition, and compensation for the loss of the export trade in pig iron is afforded by the continued expansion of the steel trade. The Tees is now exporting more manufactured iron and steel than ever before in its history. True, productive capacity has enormously increased, and the general expansion of business has by no means kept pace with the increase in the potential output of the local works. Nevertheless, it is encouraging to find that the steel export figures for the district during 1927 have beaten the figures for 1925, the last normal year, by over 200,000 tons, and have averaged 10,000 tons a month more than the previous best in 1913. The aggregate shipments of pig iron, manufactured iron and steel, from the Tees for the year just exceeded the round million tons, approximately

35,000 tons more than in 1925, and rather less than in the two preceding years.

Cleveland Iron Trade.

With the holiday feeling still in evidence, market conditions have ruled quiet this week, but re-animation is looked for in the near future. Certain firms have quite good order books, and the general situation is promising. The introduction of an eight-hour day at German iron and steel works, though the adoption of the shifts is to be accompanied by a small reduction in wages, is expected to increase cost of production, and should thus assist manufacturers here partially to recapture lost foreign trade. Cleveland pig iron is far from plentiful, and as the make fails fully to cover requirements the position of producers is a strong one. Stocks are much depleted, and values tend upwards. Price concessions are still being granted to consumers in Scotland, who place orders through makers' direct selling agency in Glasgow, but for all other home and export business fixed quotations are firm. No. 1 quality is 67s. 6d.; No. 3 G.M.B., 65s.; No. 4 foundry, 64s.; and No. 4 forge, 63s. 6d.

Hematite Pig Iron.

The increased output of East Coast hematite pig iron is being well taken up. Quotations continue to vary a good deal, but they show a tendency to steady. Consumers seldom inquire for ordinary brands, but sales of iron to special analysis are made on the basis of quotations for mixed numbers at 70s. to 70s. 6d. per ton.

Ironmaking Materials.

There seems little likelihood of early movement in the direction of renewal of negotiations for foreign ore contracts. Consumers are well bought for the first half of the year, and just at present they are not disposed to commit themselves further ahead, though sellers' suggest that as continental users have made heavy purchases for forward deliveries, supply may become somewhat scarce. Nominally, best Rubio ore remains at 21s. per ton, c.i.f. Tees. Durham blast-furnace coke makers are still prepared to sell good average qualities at 17s. 6d. per ton delivered at the works, but ironmasters are not inclined to purchase on the terms offered.

Manufactured Iron and Steel.

The steel works are again in full swing after the holidays. Inquiries are coming forward in satisfactory volume, and some of the firms are assured of active employment over the first quarter of the year. Prices are unchanged.

Shipbuilding Returns.

The fact that the output of Tyne shipbuilders during the past year was more than double that of the previous year, and of the Wear shipbuilders well over four times that of the preceding year, is due to a large extent to the low output of 1926, and the placing of contracts that had been held up by the coal strike, so that the past year's figures include some work which would normally have fallen to the credit of 1926. Nevertheless, for the Tyne to have reached a figure exceeded by only one year since the war—the boom year of 1920—is satisfactory, and the Wear's record is also the best since the boom year, with the exception of 1924, when the figures were largely increased by the launching of vessels held up in 1923 owing to the boilermakers' strike. No fewer than 137 vessels of a gross tonnage of 675,783 were launched on the North-East Coast last year. As to what this year will bring, some builders have expressed themselves not too hopefully. There is no question that shipowners, influenced by the more satisfactory trend of freight rates, are showing greater inclination to build. On the other hand, delay in giving out orders is naturally being caused by uncertainties regarding propulsion experiments and the relative costs of the use of coal and oil. Idle tonnage of cargo boats is declining, however, while other tonnage is becoming obsolescent, so that there is no reason to fear that the demand for new tonnage in 1928 will be unduly contracted.

Coal Trade Proceeds and Costs.

Some improvement in the state of the coal industry in Northumberland and Durham is indicated by the latest ascertainments. The report of the accountants for Northumberland shows that the proceeds and costs in November which would determine miners' wages in January, but for the operation of the minimum clause in the county agreement, would provide 33·49 per cent. on the basis rates, compared with 31·26 per cent. in the preceding month, an increase of 2·23 per cent. The county minimum percentage on basis wages is 80 per cent., and this will continue to operate this month, leaving the owners with a deficiency to make up of 46·51 per cent. The figure for the Durham County coalfields also shows a small improvement. The ascertainment indicates that the figures of proceeds and costs would provide for 41·11 per cent. on basis rates, as against 40·65 per cent. in the previous month, an increase of 0·46 per cent. The Durham percentage on basis rates is 89, and therefore the deficiency to be made up by the owners this month is 47·89 per cent.

The Coal Market.

There is a better tone in the export section of the Northern coal trade, as the continuance of the severely cold weather is causing many new inquiries, especially from the near continental centres. Merchants, whilst able to supply freely, find negotiations rather slow, as the continental importers are anxious as to the internal navigation. Many of the rivers and waterways are frozen, and until they are clear they are not prepared to take deliveries. Steam coals, large and small, are very steady, and gas coals are meeting with expanding trade. Coking coals and bunkers are dull at the moment, but will improve. Some grades of coke have a better tone, gas makes being firmer and ordinary patent foundry descriptions in larger inquiry.

SCOTLAND.

(From our own Correspondent.)

New Clydeside Factory.

THE Argyll motor works at Alexandria, recently acquired by the Scottish Textile Trust, will before long be utilised for the production of artificial silk and fabrics. A new textile combine, including several Scottish and English concerns, is being formed, with headquarters in Glasgow. It is reported that its activities, including the production of artificial silk and fabrics, will be on an exceptionally large scale. Some time ago it was said that an influential continental syndicate had taken an option on the Argyll motor works with a view to installing plant for the manufacture of artificial silk, but troubles arose and the deal was not completed. The property was purchased from the Government Disposals Board in June last by Scottish Textile Trust, Ltd. The Trust had previously floated Scottish Artificial Silks, Ltd., and this subsidiary already has mills at Hyde, Cheshire, near Kirkcudbright, and a recently acquired mill near Lancaster.

New Year Holidays.

Since the middle of last week and until Monday, January 9th, the steel, iron and coal markets will be more or less at a standstill, owing to the works being on holiday.

Steel and Iron.

So far as the steel industry was concerned, nothing of fresh interest occurred during the last week of 1927, and business was quiet all round, in accordance with the experiences of the past twelve months, which had a most unsatisfactory record. After the accumulation of orders, occasioned by the coal strike in 1926, was dealt with, production showed a marked falling off in practically all departments. Foreign competition was a serious factor, and despite all efforts on the part of home makers, little, if any, change was apparent. Continental prices, on occasion, showed a stiffening tendency, but in view of the disparity between home and foreign quotations, much more than a stiffening tendency is necessary to bring home prices into line as a competitive force. Business all over the period was most irregular, and of comparatively small dimensions. Although some encouragement is taken from the improvement in the shipbuilding industry, the outlook continues obscure. It has not been possible as yet to arrive at any conclusion in respect to the working of the rebate system introduced by the steel makers in September last, but one might hazard the opinion that the rebate granted would not offer any great inducement to consumers to bind themselves down to one source of supply when the concessions named were not one-quarter of the difference between home and continental quotations. At any rate, since September there does not seem to have been any definite increase in business, and the works in operation have been very indifferently employed. The various departments of the iron trade on the whole have been through a similarly unprofitable period during which various price reductions have failed to bring out any addition to business. Pig iron has perhaps been the most unsatisfactory department. After the first month or two demands began to fall off, and for the greater part of the year the reduced output was more than ample to meet all demands. Only thirty-one furnaces were in blast at December 31st, 1927, and the number is likely to be reduced this month.

Coal.

Owing to the covering of sales for December loading and the reduced output, the Scottish coal market assumed a somewhat firmer attitude, and increases of 1s. per ton in industrial fuel and washed smalls for shipment were intimated in connection with January sales. Over the last twelve months export business showed a marked falling off, almost wholly attributable to the strike of 1926. Markets lost then have not yet been regained, and the collieries in the east of Scotland, whose normal source of disposal is largely export, have been especially hard hit. The total shipments for the year show an increase of over 400,000 tons, compared with the year 1926, but this is more than accounted for by the fulfilling of contracts held up during 1926. The total shipments for 1927 amounted to 12,562,277 tons.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THE conditions in the steam coal trade have scarcely yet become normal; certainly they are still unsettled following upon the holidays and the fact that bad weather prevented the movement of tonnage, and thus dislocated the arrangements of collieries. Comparatively speaking, there was little work at the docks last week owing to the severe weather which prevailed and the absence of tonnage. The number of idle loading appliances on the Thursday at the various docks created a record for the year and actually totalled 62. It naturally follows from this, that the returns of shipments of coal for the last week of the old year were well below the average seeing that the total was only about 240,000, as against over 380,000 tons for the previous week. However, since then tonnage has come along much better, and this week began with only 12 idle loading appliances at the various docks, while there were nine steamers waiting to get into berths. The result is that the new year starts fairly well, but it is a very open question whether the loading position will remain for long so satisfactory. Tonnage offered for employment on the market is none too plentiful, and there is no doubt that the very unremunerative rates of freight which have lately been prevailing have compelled many owners to lay up their tonnage. This is reported to be especially the case with Scandinavian tonnage, and it is not at all surprising that with steamers making longer passages than usual as a consequence of bad weather, the market for prompt boats shows a steadier tendency. A number of the leading collieries are at the moment in a very comfortable position, but so far as the foreign inquiry for fresh supplies of coal is concerned, it cannot be said to be at all active.

Coal Stabilisation Scheme.

On Thursday of last week the full text of the scheme for the stabilisation of coal prices in this district was issued, but the details of the classification of coals and proposed prices were not published. There was to be a special meeting of the colliery companies at Cardiff on Thursday of this week, when the committee for the framing of the scheme was to report on the grouping of the collieries, minimum prices, &c. The main particulars of the scheme have already been published, but it should be pointed out that the question of the approval and adoption of the scheme depends entirely upon the meeting to be held this week, and it is understood that it will be necessary for a 95 per cent. majority of the members of the Association to be secured if it is to be worked with success. The agreement which will be entered into by the members is to be operative from the date of its signature until December 28th, 1928. There is no provision for it to continue after that date, and membership is open to every owner of collieries other than those employing less than fifty men or which have not raised coal since December 1st, 1927, "until coal is raised for at least four weeks and commercially disposed of." The main principles of the scheme are:—(1) Effective control by the Marketing Association of all matters appertaining to the scheme. (2) A contribution of 3d. per ton on the total output raised at each colliery in every period of four weeks. (3) Compensation not exceeding 2s. per ton on output lost owing to want of trade. (4) Grouping of collieries, classification of coals, fixing of minimum prices. (5) A penalty of 2s. per ton for selling below the minimum prices. There is one clause in the scheme dealing with the question of prices which is very interesting, and this is that minimum prices must be fixed sufficiently low to encourage an increased volume of trade, and under no circumstances must the proceeds from such prices be designed to exceed the average cost. It will therefore be seen that the scheme does not aim at making profits for collieries but simply to meet the costs of production. Average cost, of course, means the average cost of production, but from inquiries it appears that at the time of writing it had not been decided whether one average cost should be struck for the whole of the district, or whether various areas should have separate averages. It is not expected that the scheme can come into operation before the middle of the month at the earliest.

Miners' Wages.

The award of Sir Francis Taylor, the independent chairman of the South Wales Coal Conciliation Board, was received at Cardiff on Saturday, and laid before the members of the Council of the South Wales Miners' Federation. It will be recalled that the owners claimed, and the men's representatives made a counter claim for a revision of the wages agreement, but the decision of the independent chairman disposes of both. The owners applied for a reduction in the minimum from 28 to 25 per cent. and in the subsistence wage allowance a reduction from 8s. 0½d. per shift to 7s. 6d. for married men and the abolition of the allowance to single men with no parents to support. The workmen put forward counter-proposals that the minimum should be raised to 35 per cent. and the subsistence wage increased to 8s. 6d. per shift. The result of the award is that the minimum remains at 28 per cent. on the 1915 standard rates, and in the subsistence allowance the only alteration is that a reduction is made from 6d. to 4d. per shift in the flat rate allowance for youths between the ages of sixteen and twenty-one. The subsistence allowance is to be paid in respect of all shifts—including overtime, afternoon and night, and continuous shifts.

Tin-plate Trade.

Last week was a "stop" week in the tin-plate trade, and manufacturers in most cases took advantage of this and the holidays to effect repairs and improvements. In some instances steps were taken to remodel the older type of mill furnaces in order to be able to obtain uniform heat or temperature over a whole plate or sheet, thus ensuring uniformity of substance. The question of the quality of tin-plates is one that has been brought much to the front of late as one of the means of enabling manufacturers to recover markets abroad. Mr. Ernest Bevin, the general secretary of the Transport Workers, was at Swansea on Saturday last, when he addressed a meeting of the Eastern and Western Division of the Welsh Tinplate and Galvanising sections of the Transport and General Workers' Union. He referred to the keen competition prevailing and the necessity for the fullest co-operation between the workmen and the employers if the Welsh tin-plate trade was to hold its own. A resolution was adopted in which the meeting pledged itself to co-operate on equal terms with the employers to produce a sheet of such quality as would insure a ready sale in the world's markets. The view was expressed that the managements would do well to consult the men more frequently, and that their suggestions for improvements, &c., should be given full consideration.

Current Business.

Judging from the appearance of the market it will be next week before anything like settled conditions will prevail. Tonnage is out of position, but it cannot be said that there has been much of an accumulation of orders over the holidays. The tone of the markets in all branches is steady, but there is no special feature. Pitwood supplies are rather better, and quotations are round about 28s. to 28s. 6d.

CONTRACT.—The British Thomson-Houston Co., Ltd., has received orders for 367 electromagnetic automatic control equipments for motor coaches, and 194 control equipments for trailer coaches for the London Underground Railways.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0	—
No. 3 Foundry	3 10 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 10 0	3 10 0
No. 1	3 10 6	3 10 6
Cleveland—		
No. 1	3 7 6	3 7 6
Silicious Iron	3 7 6	3 7 6
No. 3 G.M.B.	3 5 0	3 5 0
No. 4 Foundry	3 4 0	3 4 0
No. 4 Forge	3 3 6	3 3 6
Mottled	3 3 0	3 3 0
White	3 3 0	3 3 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 4 6 to 3 6 0	—
(3) Northampton—		
Foundry No. 3	3 0 0 to 3 1 0	—
Forge	2 14 0	—
(3) Derbyshire—		
No. 3 Foundry	3 5 0 to 3 6 0	—
Forge	2 19 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0 to 3 5 0	—
No. 4 Forge	3 2 6	—
Basic	3 2 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 2 0 (a) / 4 5 0 (b) / 4 8 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	10 0 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	12 10 0	—
S. YORKS.—		
Crown Bars	10 10 0	—
Best Bars	11 15 0	—
Hoops	12 10 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 5 0	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0	—
Gas Tube Strip	11 10 0	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¾in. and up	8 2 6	7 12 6
Sections	7 12 6	7 2 6
Steel Sheets, ¼in.	8 17 6	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 12 6	13 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
MANCHESTER—		
Bars (Round)	8 10 0	—
,, (Small Round)	7 10 0	—
Hoops (Baling)	10 5 0	10 0 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 7 6	—
,, (Lancs. Boiler)	10 5 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 12 6 to 8 2 6	—
Intermediate Basic	7 10 0	—
Soft Basic	6 10 0	—
Hoops	10 0 0 to 10 10 0	—
Soft Wire Rods	9 0 0	—
MIDLANDS—		
Small Rolled Bars	7 7 6 to 8 0 0	—
Billets and Sheet Bars	6 0 0 to 6 5 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 0 0 to 13 5 0	—
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/- to 18/6
Block Tin (cash)	263 10 0
,, (three months)	261 5 0
Copper (cash)	61 11 3
,, (three months)	61 10 0
Spanish Lead (cash)	22 6 3
,, (three months)	22 12 6
Spelter (cash)	26 2 6
,, (three months)	26 2 6
MANCHESTER—	
Copper, Best Selected Ingots	66 10 0
,, Electrolytic	67 5 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price), lb.	0 1 0½
Brass Tubes (Basis Price), lb.	0 0 11½
,, Condenser, lb.	0 1 1½
Lead, English	23 12 6
,, Foreign	22 12 6
Spelter	26 7 6
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/4 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 17 6	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 10 0	6/6
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£36 0 0	11/6
,, ,, ,, 1 p.c. carbon	£41 10 0	15/-
,, ,, ,, 0·70 p.c. carbon	£53 0 0	17/6
,, ,, ,, carbon free	1/4 per lb.	
Metallic Chromium	3/- per lb.	
Ferro Manganese (per ton)	£13 0 0 for home, £12 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 5 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	5/- per lb.	
,, Titanium (carbon free)	0/11¼ per lb.	
Nickel (per ton)	£175	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	14/6
,, ,, Splint	17/- to 18/6
,, ,, Trebles	14/3
,, ,, Doubles	14/-
,, ,, Singles	12/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/3
,, ,, Jewel	15/3
,, ,, Trebles	14/3
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 13/-
Screened Navigation	18/-
Trebles	14/9 to 16/-
Doubles	14/3
Singles	11/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/9
Secondary Steam	12/3
Trebles	14/6
Doubles	14/3
Singles	11/9

ENGLAND.

	Inland.
(8) N.W. COAST—	
Steams	24/- to 25/-
Household	40/- to 56/-
Coke	23/- to 24/-
NORTHUMBERLAND—	
Best Steams	13/6 to 14/-
Second Steams	12/9 to 13/-
Steam Smalls	9/- to 9/9
Unscreened	13/- to 13/6
Household	21/- to 27/-
DURHAM—	
Best Gas	15/9
Second	13/9 to 14/-
Household	21/- to 27/-
Foundry Coke	19/- to 26/-
SHEFFIELD—	Inland.
Best Hand-picked Branch	27/6 to 29/6 —
Derbyshire Best Bright House	20/6 to 21/6 —
Best House Coal	19/- to 20/6 —
Screened House Coal	16/- to 17/6 —
,, ,, Nuts	15/- to 16/- —
Yorkshire Hards	14/6 to 15/6 —
Derbyshire Hards	14/- to 15/6 —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/- to 7/- —
Smalls	3/- to 4/6 —
Blast-furnace Coke (Inland)	11/- to 12/- at ovens —
Furnace and Foundry Coke (Export), f.o.b.	17/6 to 18/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/- to 19/6
Second Smokeless Large	18/6 to 19/-
Best Dry Large	18/3 to 18/9
Ordinary Dry Large	17/6 to 18/-
Best Black Vein Large	17/6 to 18/-
Western Valley Large	17/- to 17/6
Best Eastern Valley Large	17/- to 17/3
Ordinary Eastern Valley Large	16/6 to 17/-
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	11/- to 12/6
Washed Nuts	18/- to 22/-
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	14/9 to 15/3
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	11/6 to 12/6
Foundry Coke (export)	30/- to 35/-
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	22/6 to 24/-
Pitwood (ex ship)	27/3 to 27/9
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	30/- to 32/6
Seconds	25/6 to 29/-
Red Vein	20/6 to 25/-
Machine-made Cobbles	35/- to 40/-
Nuts	38/6 to 42/6
Beans	22/6 to 27/6
Peas	17/- to 18/6
Breaker Duff	8/6 to 9/-
Rubbly Culm	8/- to 8/6
Steam Coals :	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	9/9 to 10/9
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield, (c) Delivered Birmingham. (d) Rebate 7/6 joists and 5/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Outlook.

THE present state of industry offers so little cause for satisfaction that manufacturers turn their attention entirely to the possible results of the forthcoming general election which, it is hoped, will provide the necessary confidence and stability for an improvement in trade. There is nothing in the iron, steel and engineering industries to warrant a belief in an early recovery, but there is a firm conviction that the financial reconstruction is nearing a successful issue, and that if the election should allow the Government to continue its work there may be a stabilisation of the franc and a general revival of confidence in the immediate economic development of the country. The present period is one of reorganisation, a concentration of industrial interests and the creation of syndicates for the maintenance of prices, and while all manufacturers are passing through difficult times they are buoyed up with the hope that an early financial reconstruction will see the beginning of a general improvement.

Railway Charges.

At a time when it is found necessary to carry out reforms in railway management in order to avoid further heavy deficits, such as were registered last year, all kinds of suggestions are being made for effecting economies. It is remarked that the annual report of one of the leading companies shows that the railways worked four months to pay the wages, two months for capital charges, one month and a-half for coal, one month and a-half for various expenses, one month for permanent way material and maintenance of buildings, one month for the common fund to which all the companies contribute, three weeks for maintenance, repairs and renewal of material, one week for the fiscal charges and four days to pay the shareholders. It is suggested that the greatest economy can be effected by employing energy from hydro-electric plants instead of coal, but experience so far has shown that the possible economies from that source are by no means so considerable as are generally represented.

A Cantilever Bridge.

A bridge is being built over the Seine between Charenton and Ivry, just below the junction of that river with the Marne, for the purpose of carrying the cables of the Metropolitan Railway and of the Paris electricity company and the Electricité de la Seine, which are defraying the cost. It will be open to pedestrians, but will have no vehicular traffic. It rests upon two piers, each composed of two armoured concrete caissons, inside of which are driven concrete piles 15 m. to 17 m. long. The central arch has a span of 134 m. and each half span is balanced by the weight of the short end. The bridge will carry two layers of three conduits for the cables.

Flood Protection Works.

A report upon the works carried out by the Municipal Council for the pro ection of Paris after the disastrous inundation of 1910 shows that the total expenditure down to 1927 was 80 million francs. The urgent works being continued or to be put in hand, consisting largely of collectors in Paris and the suburbs, are estimated to cost another 80 million francs, and following upon these works others will have to be carried out at a cost of 26 million francs. While most prominence is given to the raising of embankments and the rapid discharge of flood water by collectors and mains, there is a vast programme for deepening the Seine and removing obstacles which will take many years to carry out, and this is not included in the above estimated cost. The dredging of the river below Paris is being continued, and an unusual undertaking is the removal of a large island outside the city, which at present divides the river in two narrow arms. The construction of barrage-reservoirs at a cost of 85 million francs is also intended to lessen the risk of floods.

Port of Marseilles.

A plan for carrying out further extensive works to the Port of Marseilles has been proposed in the hope that it will be possible to put them in hand at once with the aid of material supplied by Germany on account of reparations. The scheme provides for an enlargement of the old Jolliette basin by about two-thirds of its present area, by the construction of three moles which will provide accommodation for fifteen steamers. The new Pharo basin will be started upon, and its construction is expected to occupy from ten to fifteen years. Other important harbour works will also be put in hand at Marseilles, and at Port de Bouc the rocks at the entrance will be removed, while the dredging of a channel in the Etang de Berre, the building of docks on the south side of the Caronte, the purchase of a floating dock and other operations will complete the programme for connecting Marseilles up with the Rhone, and for providing extensive docking and anchoring facilities in the Caronte and the Etang de Berre.

Mono-rail Traffic.

A few years ago a proposal was made, and approved of officially, for installing a mono-rail on standards from which public service vehicles would be suspended and propelled by air screws between Paris and St. Denis. The journey would occupy about two minutes. It was regarded as the only means of relieving the traffic congestion of a particularly densely populated suburb. The scheme is still under consideration, and there appears some prospect of its being eventually realised as an experiment, doubtless in a modified form. General Hirschauer has now presented a more ambitious scheme, which aims at sending letters and parcels from Paris to Marseilles in a little more than two hours. Trolleys would run on electric cables carried by standards 10 m. high and would travel at a speed of 250 miles an hour.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1*s. each.*

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

275,151. January 5th, 1927.—SYSTEM OF CONNECTIONS FOR DIRECT-CURRENT SERIES TWIN MOTORS, Maschinenfabrik Oerlikon, Oerlikon, near Zürich, Switzerland.

The main part of this specification reads as follows:—Twin motors are frequently employed for electric locomotives, particularly in connection with single-axle drives. In consequence of the duplication of the armatures, the number of possible connections with such motors is greater than in the case of only one armature per driving axle. If an odd number of armatures are connected in series, the same number of field windings should be connected in each circuit, if the symmetry of the parallel circuits is to be maintained. In the case of twin motors, both fields must have their own terminals, that is to say, four field terminals are required for a twin motor without field tappings. If the motor has field tappings for weakening the

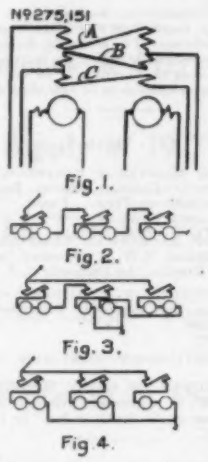


Fig. 1.

Fig. 2.

Fig. 3.

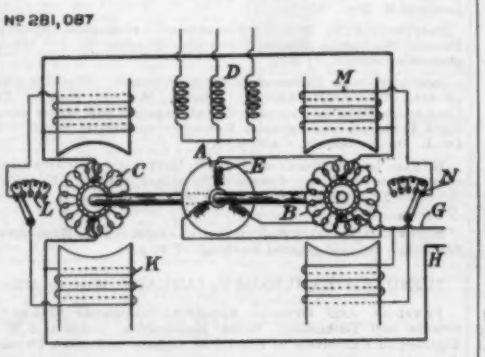
Fig. 4.

field, the number of terminals may become inconvenient. The object of the invention is to avoid the increase in the number of terminals, in the case where an odd number of armatures are connected in series. Both the field windings of each twin motor are permanently interconnected. The upper diagram—Fig. 1—illustrates the improved system of connections of a twin motor arranged for two field weakenings, the connections A, B and C being internal permanent connections. The diagrams—Figs. 2, 3 and 4—show the different connections of three of such motors for "series," "series-parallel," and "parallel" connection respectively. The advantage to be derived from the invention is demonstrated by Fig. 3, where three field windings and three twin armatures are shown connected in series in one circuit. As indicated in Fig. 1, each field winding may be provided with separately tapped coils for weakening the field.—*November 24th*, 1927.

TRANSFORMERS AND CONVERTERS.

281,087. November 23rd, 1926.—IMPROVEMENTS IN OR RELATING TO APPARATUS FOR CONVERTING ALTERNATING ELECTRIC CURRENT INTO DIRECT CURRENT, Bruce Peebles and Co., Ltd., of Edinburgh; and Jens Lassen la Cour, of Halsingborg, Sweden.

The motor converter described in this specification is for converting alternating-current power into direct-current power at high voltage. In the diagram A, B, and C represent respectively an induction motor, a rotary converter and a direct-current generator, all mounted on a common shaft. The stator windings of the induction motor A are indicated at D and its rotor windings E are connected in cascade with the windings

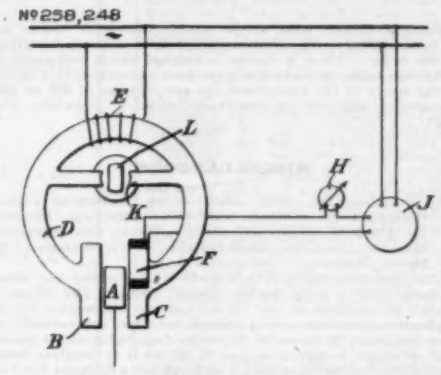


of the rotary converter. The armatures of the direct-current generator C and the rotary converter B are connected as shown in series in the output circuit G H, and preferably when the set is used for supplying high-voltage direct current to a railway or other system the conductor G joined directly to the one brush of the rotary converter is connected to the earthed side of the system, whilst the conductor H is connected to the overhead line or equivalent conductor. The field magnets of the direct-current generator C and the rotary converter B are shunt wound, the winding K of the direct-current generator being provided with a regulating resistance L and the winding M of the rotary converter being similarly provided with a regulating resistance N. The design of the three machines A, B, and C is such that nearly all the mechanical power transmitted from the stator to the rotor of the induction motor is absorbed by the direct-current generator C and converted by it into direct-current power, the rotary converter B dealing almost solely with the alternating-current power transmitted electrically from the stator D to the rotor E, this alternating-current power being converted in the rotary converter B to direct-current power. The power factor of the whole set may be adjusted by varying the excitation of the field coils M of the rotary converter through the resistance N without altering the direct-current output voltage, and that voltage may be adjusted independently of the power factor on the alternating-current side by varying the excitation of the field coils K of the direct-current generator by means of the resistance L.—*December 1st*, 1927

MEASURING AND TESTING INSTRUMENTS.

258,248. August 31st, 1926.—IMPROVEMENTS RELATING TO FLOW-MEASURING APPARATUS, Siemens and Halske Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

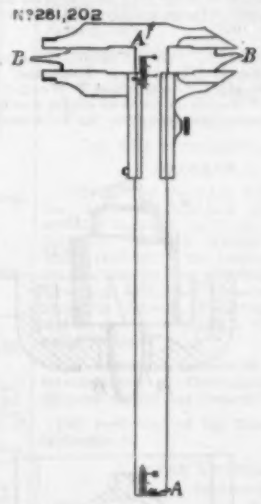
In accordance with this invention means are provided for changing an electric inductance according to the change of the rate of flow of steam or vapour by the displacement of an iron core, and means are provided for correcting the measured value according to the pressure or temperature, or both. A differential pressure meter, which is not shown in the diagram, is connected with a movable iron core A, which slides between the pole shoes B and C of a yoke D, excited by means of a coil E, fed with alternating current. At F there is a secondary coil, and the



number of magnetic lines traversing this coil increases with the upward movement of the armature A. The current generated in the coil F consequently becomes stronger. This current is shown on an ammeter H, and it is also passed through a watt-meter J, so that the meter H registers the rate and the meter J the total quantity of steam or vapour through the pipe within any period of time. In order that the indication of the instruments may be corrected according to the temperature and pressure of the steam or vapour, an adjustable magnetic shunt is provided at K. The armature L of this shunt is attached to the indicator of a temperature or pressure gauge, so that if an alteration occurs in the temperature or pressure, the armature K will rotate.—*November 24th*, 1927.

281,202. July 27th 1927.—TRUING UP THE JAWS OF SLIDING CALLIPERS, M. A. Borel, 14, Faubourg St. Etienne, Pontarlier, France.

The essence of this idea is to assure the precise registration of the jaws of sliding callipers. For this purpose the stock is, accord-



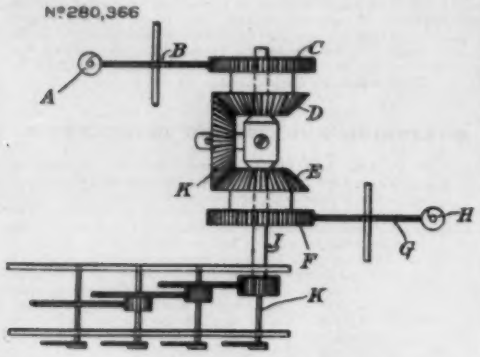
ing to the inventor, provided with "centre pops" at A A and is then mounted in a grinding machine. Then, by rotating the callipers between the centres, the two pairs of faces B B can be made truly parallel and in line.—*December 1st*, 1927.

280,366. November 23rd, 1926.—IMPROVEMENTS RELATING TO ELECTRICITY METERS, Chamberlain and Hookham, Ltd., and Samuel James, both of 4, New Bartholomew-street, Birmingham.

Owing to bearing friction electricity meters of the motor type are liable to small errors in favour of the consumer, especially at light loads. The object of the invention is to provide an improved meter which runs continuously and in which the rotation of the armature on no load is prevented from affecting the meter registrations in a more simple and satisfactory manner than usual. A worm A actuated by the usual metering element is caused to rotate through wheels B and C, one of the sun pinions D forming part of an epicyclic mechanism. The other sun pinion E is driven through wheels F, G, from a worm H, which is actuated at a substantially constant speed by a small motor clock. When the sun pinions are driven at the same speed, as is the case when no current is being taken by the consumer, the equal and opposite actions are applied to the planet pinion K, with the result that the latter, from which motion is transmitted by the spindle J to the registering, counting or indicating mechanism K, receives no movement. As soon, however, as current is taken by the consumer the sun pinion

D, driven by the metering element rotates correspondingly faster than the other E, and an appropriate movement is transmitted by the planet pinion K to the indicating mechanism. To avoid errors due to variations in the voltage or frequency of the supply altering the ratio of the speeds of the meter and the motor when no load is passing in the consumer's

No 280,366



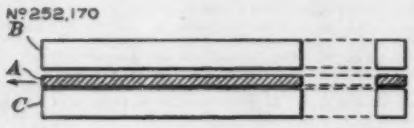
circuit, a motor with shunt characteristics is used, and it is designed to have substantially the same characteristic as the meter. Thus, a change in voltage which will make the meter run faster on no load will produce a corresponding change in the speed of the motor and the cancellation of the no load registration will still be accurately effected.—*November 17th*, 1927.

MISCELLANEOUS.

252,170. May 12th, 1926.—METHOD OF RENDERING VISIBLE OSCILLATIONS OF PIEZO-ELECTRICAL CRYSTALS, Professor Dr. Erich Giebe, of 7–8, Schlossstrasse, Charlottenburg, Germany, and Dr. Adolf Scheibe, of 17, Waterloo-Ufer, Berlin, Germany.

This invention relates to a method of making the elastic oscillations of a piezo-electric crystal visible. The crystal is caused to oscillate at one of its natural frequencies by the application of an alternating-current voltage of substantially the same frequency by means of electrodes disposed in such a manner with reference to the crystal as to permit it to oscillate freely. One of the electrodes is spaced at a sufficient distance from the

No 252,170

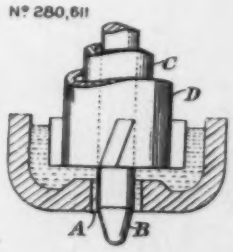


crystal to leave an intermediate space, which is filled with rarified air or a gas other than air, which is rarified in order that the piezo-electric voltage may give rise to ionisation of the air or other gas and may produce a luminous effect characteristic of the particular frequency. In the drawing the crystal shown at A, is a few centimetres long, and cross section of a few square millimetres. B and C are the two metal electrodes which are connected with the source of alternating-current voltage. By properly adjusting the space between the rod A and the electrode B and the alternating voltage impressed upon the electrodes C and B, a luminous effect may be produced which makes the oscillations visible between the crystal A and the electrode B.—*November 14th*, 1927.

289,611. June 18th, 1926.—FEEDING MOLTEN GLASS, The British Hartford-Fairmount Syndicate, Ltd., Audrey House, Ely-place, London, and T. Wardley.

The object of this invention is to ensure a uniform quality of molten glass being delivered from the forehearth of a furnace.

No 289,611

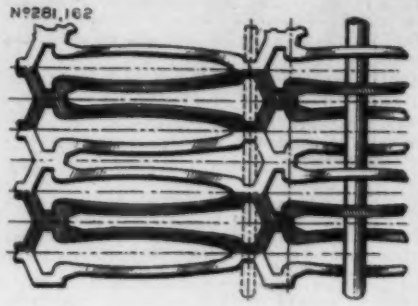


The glass is discharged from the opening A, and is controlled by the plunger B. C is a sleeve which regulates the rate of flow and D is another sleeve furnished with radial paddles. This sleeve is rotated and consequently stirs up the molten glass.—*November 16th*, 1927.

281,162. April 27th, 1927.—EXPANDED SHEET METAL, F. Humphris, Park House, Park-road, Parkstone, Dorset.

The chief interest in this specification really lies in the fact that it is concerned with a by-product, although the fact is not mentioned. The expanded metal illustrated is the scrap left after punching out in a process for making nails, but is in itself useful for reinforcing work. The principal claim in the specification reads as follows:—"Sheet metal perforated and bent, or slit and expanded and bent in such a manner that a meshwork is formed having both lengthwise and transverse rows of cupped meshes with two independent strands to form each cupped mesh thereof and with a row of apertures or openings at the side of each lengthwise row of cupped meshes and with each lengthwise row of cupped meshes inverted in relation to that lengthwise

No 281,162



row of cupped meshes integrally connected therewith and next to it."—*December 1st*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN STUDENTS' SECTION.—Lighting Service Bureau, Northumberland-street, Newcastle-on-Tyne. Paper, "Protective Gear," by Mr. H. C. Atkins. 7.15 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, Westminster, London, S.W. 1. Thomas Lowe Gray Lecture, "The Marine Oil Engine," by Professor C. J. Hawkes. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Exhibition of Instruments and Scientific Appliances. 6 p.m.

SATURDAY, JANUARY 7TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Juvenile Christmas lecture, "Engines—(5) Putting the Furnace in the Cylinder," by Professor E. N. da C. Andrade. 3 p.m.

MONDAY, JANUARY 9TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Open discussion on various subjects. 7.30 p.m.

SURVEYORS' INSTITUTION.—12 Great George-street, Westminster, London, S.W. 1. Paper, "The Reports of the Royal Commission on Mining Subsidence," by Mr. C. H. Bailey. 8 p.m.

TUESDAY, JANUARY 10TH.

INSTITUTE OF MARINE ENGINEERS.—85–88, The Minories, Tower Hill, London, E. 1. Paper, "The Effect of Type and Disposition of Machinery on the Strength of Ships," by Mr. T. R. Thomas. 6.30 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "Permanent Mould Casting in Aluminium Alloys," by Mr. G. Mortimer. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: COVENTRY CENTRE.—Broadgate Café, Coventry. Paper, "The Viewpoint of the Owner Driver," by Mr. M. Platt. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Paper, "Standards of Thermal Efficiency for Internal Combustion Motors," by Sir Dugald Clerk. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—North British Hotel, Edinburgh. Paper, "Storage Batteries in Relation to Modern Supply of Electric Lighting and Power," by Mr. E. C. McKinnon. 7 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—Denison House, 296, Vauxhall Bridge-road, London, S.W. 1. Lecture, "Some Constructional Details of a High-pressure Locomotive," by Mr. Lawford H. Fry. 6 p.m.

INSTITUTION OF MINING ENGINEERS.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Annual general meeting. 11 a.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Connection Between Commercial Oil Deposits and Major Structural Features, with Special Reference to Asiatic Fields," by Dr. L. Dudley Stamp. 5.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Juvenile Christmas lecture, "Engines—(6) Heat Engines which Produce Cold," by Professor E. N. da Andrade. 3 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. Annual general meeting. 7.30 p.m.

TUESDAY TO THURSDAY, JANUARY 10TH TO 12TH.

PHYSICAL AND OPTICAL SOCIETIES.—Imperial College of Science and Technology, South Kensington, London, S.W. 7. Eighteenth Exhibition of Electrical, Optical and other Physical Apparatus.

WEDNESDAY, JANUARY 11TH.

INSTITUTE OF FUEL.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The Utilisation of Town's Refuse and Refuse Fuels," by Mr. A. B. Scorer. 6 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Informal meeting. Discussion on "The Effect of Acceleration and Deceleration on the Wear of Railway Track," opened by Mr. R. T. Smith. 6 p.m.

INSTITUTION OF ENGINEERS-IN-CHIEF.—St. Bride Institute, Bride-lane, Fleet-street, London, E.C. 4. Paper, "Modern Steels," by Mr. L. K. Everitt. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: MIDDLESBROUGH BRANCH.—Cleveland Scientific and Technical Institution, Middlesbrough. Graduate Section meeting. "Colliers," by Mr. G. Booth. 7.30 p.m.

OVERHEAD LINES ASSOCIATION.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. "French Regulations," by Major Theodore Rich. 5.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Dr. Mann Juvenile Lecture, "Flame," by Professor Arthur Smithells. 3 p.m.

SOCIETY OF TECHNICAL ENGINEERS: LONDON BRANCH.—102, Belgrave-road, London, S.W. 1. "Industrial Prosperity in the United States: Report on a Visit of Investigation," by Mr. P. A. Molteno. 7.45 p.m.

THURSDAY, JANUARY 12TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, London S.W. 1. "Corrosion, with Special Reference to Standard Tests," by Dr. G. D. Bengough. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM CENTRE.—Grand Hotel, Birmingham. Joint meeting with the Institution of the Rubber Industry. Paper, "Indiarubber as an Auxiliary to Suspension," by Dr. F. W. Lanchester. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Chamber of Commerce, New-street, Birmingham. Paper, "The Development of Heating of Buildings," by Mr. A. J. P. Pashler. 6 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS.—10, Upper Belgrave-street, London, S.W. 1. Paper, "Structural Engineering in Warfare," by Major A. H. S. Waters. 8 p.m.

FRIDAY, JANUARY 13TH.

CHEMICAL ENGINEERING GROUP.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The Manufacture of Artificial Silk, with Special Reference to Viscose," by Mr. H. R. S. Clotworthy. 8 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Air Conditioning—a General Survey of its Uses and Application," by Mr. N. E. Jackson. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Mining Institute, Newcastle-upon-Tyne. Paper, "Diesel Engine Drive for Generators and Other Auxiliary Machinery on Board Ship," by Mr. J. Calderwood. 6 p.m.

MONDAY, JANUARY 16TH.

RAILWAY CLUB.—25, Tothill-street, London, S.W. 1. Paper, "Timetables, Old and New," by Lieut.-Colonel W. R. Mansfield. 7.30 p.m.

WEDNESDAY, JANUARY 18TH.

NEWCOMEN SOCIETY.—Prince Henry's Room, 17, Fleet-street, London, E.C. 4. Paper, "Some Episodes in Early Ocean Steam Navigation," by Engineer-Captain E. C. Smith. 5.30 p.m.

CALENDARS, DIARIES, &c.

DAVIDSON AND CO., Ltd., Belfast.—Greeting card.

ALFRED HERBERT, Ltd., Coventry.—Pocket diary.

BIRMINGHAM SMALL ARMS COMPANY, Ltd., Birmingham.—Ash tray.

STANTON IRONWORKS COMPANY, Ltd., near Nottingham.—Pocket diary.

A. BORSIG, Tegel.—Desk memorandum tablet with fortnightly tear-off sheets.

HOPKINSONS, Ltd., Huddersfield.—Desk calendar with monthly cards.

THE STAVELEY COAL AND IRON COMPANY, Ltd., near Chesterfield.—Pocket diary.

NOBLE AND HOARE, Ltd., Cornwall-road, Stamford-street, S.E. 1.—Pocket diary.

RUSTON AND HORNSBY, Ltd., Lincoln.—Wall calendar with monthly tear-off sheets.

THOMAS ROBINSON AND SON, Ltd., Rochdale.—Wall calendar with daily tear-off sheets.

J. W. BROOKE AND CO., Ltd., Lowestoft.—Wall calendar with monthly tear-off slips.

BRAITHWAITE AND CO. (ENGINEERS), Ltd., Broadway Buildings, S.W. 1.—Pocket diary.

ASHWELL AND NESBIT, Ltd., Barkby-lane, Leicester.—Wall calendar with daily tear-off slips.

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—Desk calendar with monthly cards.

THOMAS BROADBENT AND SONS, Ltd., Huddersfield.—Memorandum tablet with calendar.

BRISTOL AEROPLANE COMPANY, Ltd., Filton, Bristol.—Wall calendar with monthly tear-off sheets.

SENTINEL WAGGON WORKS, Ltd., London and Shrewsbury.—Wall calendar with monthly cards.

THE WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY, 150, Broadway, New York, U.S.A.—Pocket diary.

NOAKES BROS., 19, St. Bride-street, E.C. 4.—Wall calendar with daily and monthly tear-off sheets.

C. A. PARSONS AND CO., Ltd., Heaton Works, Newcastle-on-Tyne.—Wall calendar with monthly cards.

D.P. BATTERY COMPANY, Ltd., Bakewell, Derbyshire.—Wall calendar with monthly tear-off slips.

GEAR GRINDING COMPANY, Ltd., Handsworth, Birmingham.—Wall calendar with monthly tear-off sheets.

HART ACCUMULATOR COMPANY, Ltd., Stratford, E. 15.—Desk blotter and wall calendar with monthly tear-off sheets.

R. AND W. HAWTHORN, LESLIE AND CO., Ltd., Newcastle-on-Tyne.—Wall calendar with monthly and daily tear-off slips.

IRONITE COMPANY, Ltd., 11, Old Queen-street, S.W. 1.—Wall calendar with monthly tear-off sheets.

LAW LAND BUILDING DEPT., Ltd., 30, Norfolk-street, Strand, W.C. 2.—Pocket diary and memorandum book.

NEWTON, CHAMBERS AND CO., Ltd., Thorncliffe Ironworks, near Sheffield.—Wall calendar with daily tear-off sheets.

"CHEMICAL TRADE JOURNAL" AND "CHEMICAL ENGINEER," 265, Strand, W.C. 2.—Wall calendar with monthly tear-off sheets.

RD. JOHNSON, CLAPHAM AND MORRIS, Ltd., Jacem House, Trafford Park, Manchester.—Wall calendar with monthly tear-off sheets.

THE REASON MANUFACTURING COMPANY, Ltd., Lewes-road, Brighton, Sussex.—"Interlox" master slide rule. Refill cards for desk calendar.